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Monticello Remedial Action Project

RADIOLOGIC CHARACTERIZATION OF THE PERIPHERAL PROPERTIES ADJACENT TO THE MONTICELLO, UTAH, MILLSITE

April 1985

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Monticello Remedial Action Project

RADIOLOGIC CHARACTERIZATION OF THE PERIPHERAL
PROPERTIES ADJACENT TO THE MONTICELLO, UTAH, MILLSITE

Sammy J. Marutzky
Callie Ridolfi
David Traub
Susan Knutson
Bruce W. Walker

Bendix Field Engineering Corporation
Grand Junction, Colorado

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EXECUTIVE SUMMARY

This radiologic characterization of the peripheral properties surrounding the inactive uranium millsite at Monticello, Utah, was conducted by Bendix Field Engineering Corporation for the U.S. Department of Energy under the Surplus Facilities Management Program. The objectives of this study were to determine which properties are eligible for remedial action using the U.S. Environmental Protection Agency (EPA) standards as criteria and to determine the volume of contaminated material requiring removal. The total area surveyed for this study covers approximately one square mile surrounding the millsite and tailings piles, excluding the residential properties to the northwest.

Extensive areas in and around the Monticello millsite are characterized by surface radium concentrations that exceed the EPA standard of 5 pCi(Ra-226)/g above background. Although previous cleanup activity had brought the former ore-storage areas into compliance with earlier standards, it is these areas that contain the largest volume of material requiring removal to meet current standards. The contaminated area is bounded by Highway 163 on the west and by the southern perimeter of the former ore-storage area on the south. Areas of windblown contamination extend into the residential properties to the north; characterization of these areas, however, was beyond the scope of this study.

To the east, radium contamination occurs at least two miles downstream from the millsite at the confluence of Montezuma and Vega Creeks, indicating that contamination is migrating off-site via Montezuma Creek. Areas characterized by radium concentrations of 6 pCi/g or more are confined to the banks of Montezuma Creek east of the gridline at 2000 feet east. West of this line, it appears that mill tailings have been used to level the ground around the creek and to bury irrigation pipes.

An irrigation ditch that runs through the north end of the millsite has also carried contamination downstream to an area east of the electrical substation, where the ditch apparently pools into a stockpond. East of the gridline at 1000 feet east, contamination occurs only in the ditch and on the banks where dredged material has been piled.

Results of radiometric surveys performed in the buildings remaining on the millsite indicate that only two exceed the EPA limits for indoor gamma-ray exposure rates. It is recommended, however, that radon monitoring be implemented to determine whether these and other buildings exceed the working-level limit for indoor radon concentration.

Using data collected from four background locations surrounding the study area, the background radium concentration was determined to be 1 pCi/g. The average potassium and thorium concentrations are 1.7 percent and 7 ppm, respectively. Concentrations of these radioelements do not vary significantly within a radius of several miles of the millsite. The average background gamma-ray exposure rate for the study area is 14.7 μ R/h.

Decontamination to meet EPA standards will require removal of an estimated 302,236 yd^3 of contaminated surface material from the peripheral properties. Approximately 278,000 yd^3 of this material lies adjacent to the millsite, the remainder along Montezuma Creek and the irrigation ditch north of the millsite.

1.0 INTRODUCTION

This radiologic characterization of the peripheral properties surrounding the inactive uranium millsite at Monticello, Utah, was conducted by Bendix Field Engineering Corporation (Bendix) for the U.S. Department of Energy (DOE) under the Surplus Facilities Management Program (SFMP). The objectives of this study were to determine which properties are eligible for remedial action using as criteria the U.S. Environmental Protection Agency (EPA) standards (U.S. Environmental Protection Agency, 1983) and to determine the volume of contaminated material requiring removal. The data presented in this report are required for characterization of the areas adjacent to the tailings piles and for the subsequent design of cleanup activities.

An orientation visit to the study area was conducted on 17 April 1984. Fieldwork was conducted from 15 July to 17 August 1984.

2.0 BACKGROUND

For a detailed description of the Monticello millsite, including location, history, and current geologic and hydrologic conditions, refer to the Monticello Remedial Action Project Site Analysis Report (Abramink and others, 1984).

2.1 LOCATION

The Monticello millsite is located just southeast of the City of Monticello in San Juan County, Utah (see Figure 1). It lies in Section 36, Township 33 South, Range 23 East, and Section 31, Township 33 South, Range 24 East (Salt Lake Meridian). Elevations of the millsite range from 6990 ft at the northwest corner to 6820 ft at the southeast corner. Elevations of the peripheral areas surveyed during this study range from 6700 to 7000 ft above sea level.

2.2 HISTORY OF THE MILLSITE

The Monticello mill was operated from 1942 to 1946 and again from 1948 to 1960 to support various Government projects. Beginning in 1942, the Vanadium Corporation of America operated the mill for recovery of vanadium from the uranium/vanadium ores of the Colorado Plateau. Production of uranium began in 1943; in 1944 the mill closed. During 1945 and 1946, a uranium/vanadium sludge was produced, which was sold to the Manhattan Engineer District. The Atomic Energy Commission bought the site in 1948 and operated the mill primarily for uranium recovery until 1 January 1960, at which time the mill was permanently closed. The ore-buying station, which opened in 1940, ceased operation in 1962.

The first in a series of cleanup activities at the site was initiated in 1961. An attempt was made to stabilize the four tailings piles (see Figure 2 for locations) by covering them with several inches of clean topsoil and planting a variety of native grasses. Some of the mill facilities were dismantled, and unsold contaminated scrap material was buried or burned. In 1965 several inches of topsoil was removed from the ore-storage areas when results of a

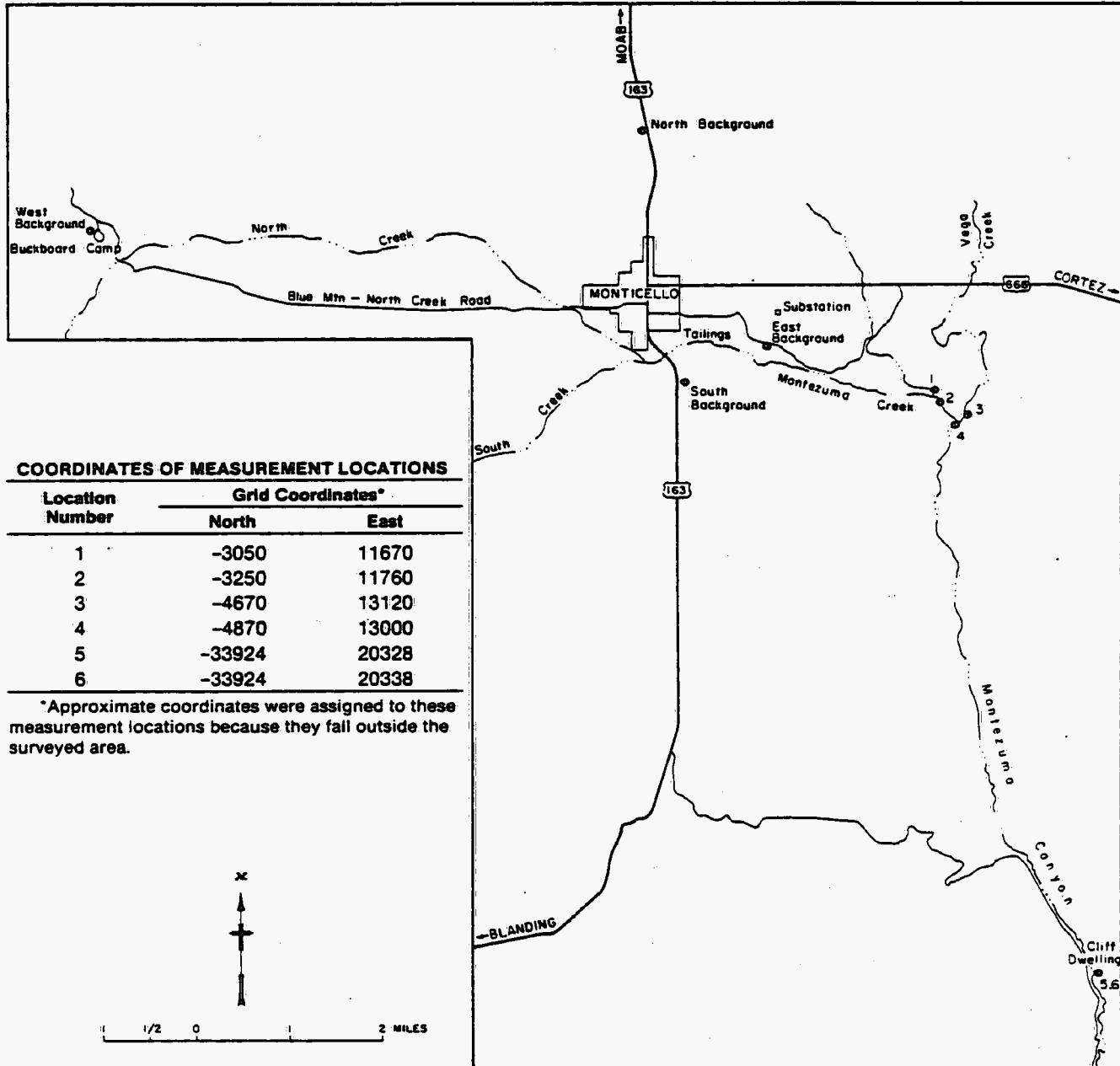


Figure 1. Map of the Study Area Showing Measurement Locations for Background and Those Along Montezuma Creek Further Than 2 Miles from the Millsite

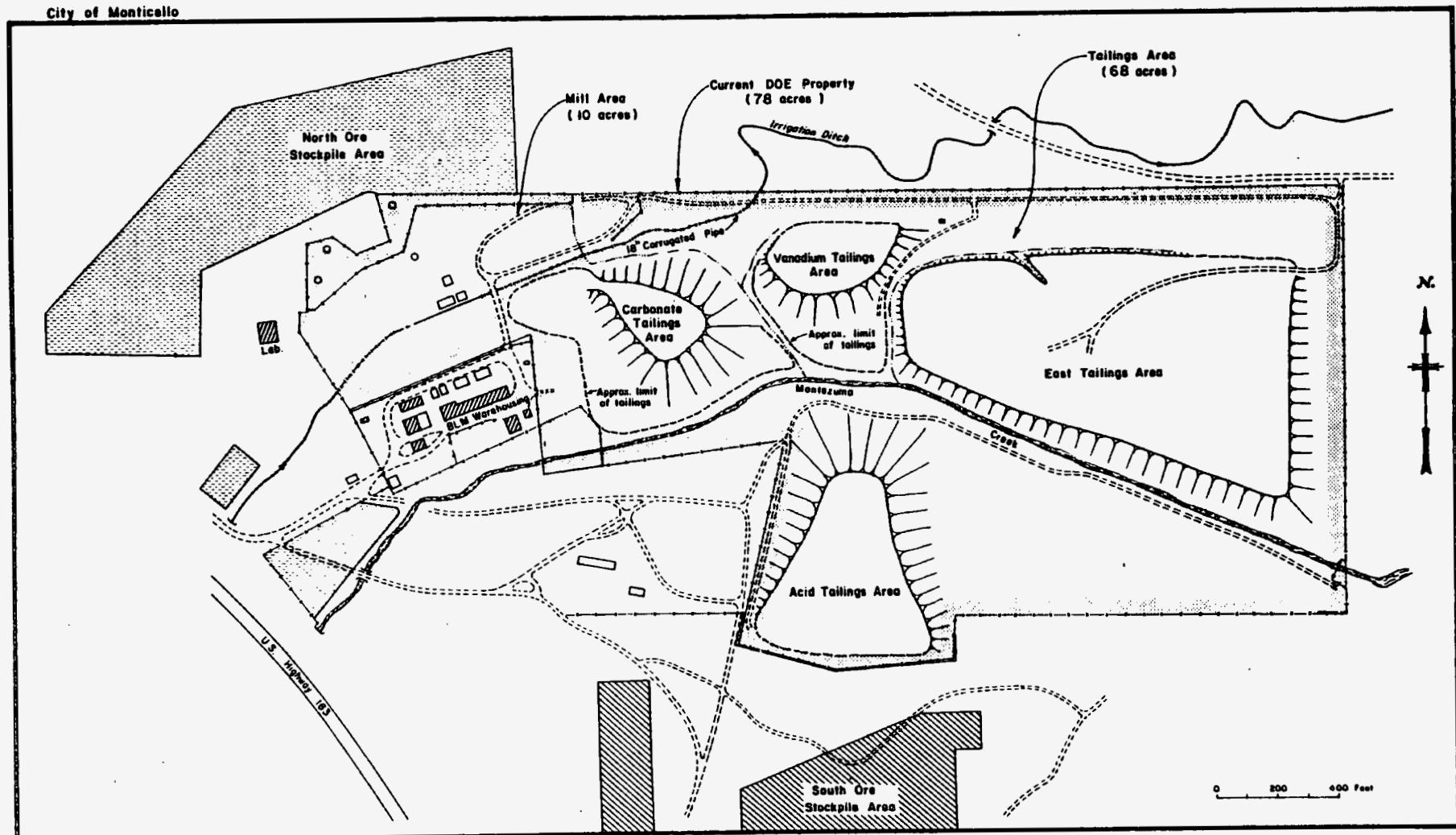


Figure 2. Plan View of the Monticello Millsite (from Abramiuk and others, 1984)

radiologic survey indicated contamination in those areas. Despite these efforts, a radiologic survey performed in 1972 indicated that considerable contamination still remained in those areas (Ward, 1972; Freytag, 1972). In 1974 and 1975, the ore-storage areas and the ore-buying station were again decontaminated by removing several inches of topsoil. Foundations on the millsite were demolished and buried in place. A subsequent radiologic survey indicated that exposure rates had been reduced to less than 40 $\mu\text{R}/\text{h}$ above background (Ward and Gisler, 1976).

2.3 CONDITIONS OF THE STUDY AREA

The total area surveyed for this Monticello peripheral properties study encompasses approximately one square mile surrounding the millsite and tailings piles, excluding the residential properties to the northwest (see Plates 1a and 1b).

The areas north and east of the millsite are used mainly for agricultural purposes—grazing, stockponds, alfalfa fields, and some residences. Much of the land to the north has been undisturbed and is primarily used for grazing.

The area south of the millsite is used for grazing and is otherwise undisturbed. The dominant vegetation comprises cedar and pine trees and oak brush, except in the south ore-storage area where the original topsoil was removed some years ago; vegetation in this latter area therefore consists of smaller plants such as sagebrush. Isolated pockets of residual uranium-bearing material were found in the ore-storage area.

West of the millsite, thick oak brush and wild roses cover most of the area from Highway 163 to the west fence, except for the ore-storage and ore-buying area in the northwest and the former housing area to the southwest. Again, pockets of uranium-bearing material remain in these areas.

3.0 PROCEDURES

The measurement techniques, instrumentation, and procedures used for the Monticello peripheral properties study were based primarily on protocols developed by the DOE Division of Remedial Action Projects (DRAP) Technical Measurements Center (TMC) and on field-implementation experience gained during radiologic characterizations of Uranium Mill Tailings Remedial Action (UMTRA) sites (Allen, Showalter, and Shay, 1983; Allen, Steele, and others, 1983; Allen and Strong, 1984; Marutzky and others, 1983; Shay and others, 1984; Shay and Rush, 1984; Goodknight and Walker, 1984).

For purposes of this study, radiometric measurements made indirectly by measurement of radiation from sources other than the decay of the nuclide of interest are reported as 'equivalent' concentrations, denoted by an 'e' prefix, i.e., $\text{pCi}(\text{eRa-226})/\text{g}$. Similarly, 'e' is used to report equivalent elemental concentrations (i.e., eK , eTh) calculated from the natural abundance of the nuclide (K-40 for eK) or a daughter in equilibrium with the parent (Tl-208 for eTh).

All instruments used for radiologic characterization were calibrated at the DOE calibration facilities in Grand Junction, Colorado, both before and after the fieldwork session. Calibration factors for the spectrometer and delta-gamma units are presented in Appendix A, Figures A-1 through A-6. Instrument-response field checks were made before use each day, and the results were monitored for compliance with quality-control limits established on the statistical basis of previous response checks. The methods used for instrument-response field checks are described in Appendix A.

Data collected during the fieldwork were entered into the data base for the study using a Zenith-100 microcomputer system, and were verified in accord with prescribed quality-assurance procedures.

3.1 PHYSICAL SURVEY

The purpose of the physical survey was to establish a grid network around the Monticello millsite on 200-foot centers. The steep terrain and dense vegetation to the north, south, and west made surveying the area difficult. To accomplish the survey, three baselines were established using a Theodolite and Geodimeter, two running east-west at zero and 100 ft south and one running north-south at 2000 ft west (-2000E). Four control points, marked with brass caps, were used to establish the baselines: at the quarter corner of Section 31 (0N, 0E); on the south (acid) tailings pile (-891.1N, -1465.8E); on the hill above the millsite (-524.6N, -3885.0E); and on Highway 163 west of the millsite (-1734.3N, -3048.6E). Once the baselines were established, gridpoints were located by turning right angles to the baseline and measuring the distance. Certain areas were surveyed using a steel tape along a line-of-sight between existing gridpoints. Points along Montezuma Creek were set by extending the -1400N line eastward to 3600E, then extending the -2600N line east to 6000E. Right angles were turned from each point on the baseline to locate the gridpoint on each side of the creek.

Elevations of augered holes were established by means of differential leveling from benchmarks with known elevations. Five level traverses were run, one each to the north, south, and east, and two toward the west.

3.2 SOIL SAMPLING AND ANALYSIS

Soil samples were collected at each gridpoint, and at 'hot spots,' i.e., between gridpoints whenever the exposure-rate measurement at one point exceeded that at the previous point by 10 $\mu\text{R}/\text{h}$ (see Section 3.3.5). The primary purpose of collecting the soil samples was to determine radium concentrations by laboratory analysis, although the samples were also analyzed for potassium and thorium, using gamma-ray-spectroscopic methods. Moisture content was determined in the laboratory for each soil sample by drying (see Section 3.3.3). Twenty-one samples were analyzed for uranium and vanadium using chemical separation followed by alpha spectroscopy (Donivan and others, 1982).

Several steps were taken to ensure the integrity of the soil samples during the soil-sampling process. The samples were excavated with a shovel specially constructed to consistently produce samples of equal size. Care was taken to collect a uniform vertical cross section of the 6-inch layer

sampled. A paper record of the sample-ticket number was placed inside the plastic sample bag along with the sample, and the top was folded twice and stapled shut to retain moisture. The sample number and the location coordinates were marked on the outside of the plastic bag, which was then placed inside a canvas bag. The canvas bag was tied shut and labeled with the sample number. Location coordinates were recorded on the sample ticket, together with such pertinent information as the formation or type of material sampled, depth, date, sampler's initials, and any unusual sampling conditions. The shovel was cleaned as necessary between samples to prevent cross-contamination.

Following transport to Grand Junction, soil samples to be analyzed for radium were weighed, dried, reweighed, crushed and ground to -28 mesh, blended, and sealed in sample cans. The samples were then stored for at least 21 days to allow the radon and radon daughters to reach equilibrium with any radium present. The samples were analyzed for radium, potassium, and thorium, using high-resolution germanium gamma-ray-spectroscopy systems. The systems were calibrated against the New Brunswick Laboratory (NBL) Series 100-A certified gamma-ray standards. All samples were positioned on a detector by means of an automatic sample changer to maintain consistent sample/detector geometry. The laboratory procedures used are described in detail in the Handbook of Analytical and Sample-Preparation Methods (Bendix Field Engineering Corporation, 1984).

Amplifier gain and baseline were manually checked daily, using a Th-232 source. Two known control samples were analyzed each day; acceptance of the data set thus generated required that at least one control be within one standard deviation and that both controls be within two standard deviations of the statistically established individual ranges. In addition to analysis of known controls, 10 percent of the blended samples were split and analyzed for radium concentration as blind duplicates.

Samples for isotopic analysis were split from the soil samples prepared for radium analysis, crushed to -100 mesh, and blended. The alpha-spectroscopic method used for this analysis is described in Donivan and others, 1982; Francois, 1958; and Bendix Field Engineering Corporation, 1984.

3.3 SURFACE RADIOMETRIC MEASUREMENTS AND CORRECTION FACTORS

3.3.1 Delta-Gamma Radium Measurements

In-situ measurements of equivalent radium were made using two types of delta-gamma systems, one a modified Mount Sopris DS-1275 sodium iodide scintillation detector connected to a Mount Sopris PS-872A portable scaler, and the other a Bendix delta-gamma system. The Mount Sopris detector was modified by addition of external collimation and an internal nonremovable prefilter. The Bendix system was built with internal collimation and prefilters. These features aid in minimizing the effects of adjacent sources of radiation.

The systems were operated on counting plateau using a delta (difference) technique. The detector was placed on the surface to be assayed and an UP count was collected for up to 300 seconds; a high-density shield was then

placed between the detector and the surface being assayed and a DOWN count of up to 300 seconds (corresponding to the UP count) was collected. The up/down counter automatically registered the difference or delta count.

The statistical validity of the delta-gamma measurements was monitored in the field by taking two or more sets of measurements at each location. The mean of the count sets was determined arithmetically, and the standard deviation of each count set was calculated using the equation

$$\sigma = (2N_u - N_d)^{1/2} \quad (1)$$

where σ is the standard deviation and N_u and N_d are the unshielded (UP) counts and the difference or delta counts, respectively. The individual delta counts were considered acceptable if they fell within two standard deviations of the calculated mean and if the standard deviation divided by the sum of the difference counts was less than 0.15. If either criterion could not be met within three measurements, a soil sample was collected and the measurement data were marked for qualitative analysis only.

A calibration factor and three major corrections were applied to the raw delta readings to obtain radium concentrations in picoCuries of equivalent radium per gram [$\text{pCi}(e\text{Ra-226})/\text{g}$]. Calibration of the instruments was performed at the Department of Energy (DOE) Walker Field calibration pads in Grand Junction, Colorado. The stripping factors necessary to calculate raw equivalent-radium concentrations from the delta readings were obtained from the calibration data and are presented in Appendix A.

A correction for contributions from radioelements other than Ra-226 was made to compensate for the fact that the raw data collected in the delta-gamma measurements are the result of all gamma radiation reaching the detector. In the field, to provide best estimates for guidance of the surveys, this correction was derived from average potassium and thorium concentrations that were obtained from laboratory analysis of soil samples collected during the orientation visit and from in-situ spectrometer measurements. In this report, to correct the data, average potassium and thorium concentrations for the study area were determined from gamma-ray-spectroscopic analysis of soil samples collected during the main field survey.

A correction for soil-moisture content was also applied to the data for two reasons: soil moisture reduces the total gamma-ray flux at the surface, and concentrations are conventionally based on dry sample weight. This correction factor was obtained through laboratory loss-on-drying measurements performed on soil samples taken during the main field survey.

A third correction was applied to account for the disequilibrium between radium and its gamma-emitting daughter products (see Section 3.3.4). This disequilibrium is due to loss of radon gas, radium's first daughter, from the soil.

Delta-gamma measurements were made at all of the gridpoint and hot-spot locations. At most of the gridpoints, a delta-gamma measurement was made on the surface, and then a surface (0 to 6 in.) soil sample was collected. Following collection of the sample, an area approximately 6 in. by 12 in. in size, centered on the soil-sample hole, was excavated to a depth of 6 in., and a

delta-gamma measurement was made on the resulting surface. Where the measured radium concentration at depth exceeded 5 pCi/g above background, a subsurface soil sample (6 to 12 in. deep) was collected to ensure compliance with the EPA standard of 5 pCi/g above background; this standard applies to areas that may be excavated, but will not subsequently be backfilled with 15 cm or more of soil. Another delta-gamma measurement was then made at a depth of 12 in. If the measured radium again exceeded 5 pCi/g above background, the point was flagged as a potential auger hole. Working away from the millsite, if surface delta-gamma measurements at two consecutive gridpoints indicated radium-226 concentrations below 5 pCi/g, no further surveying on that line was done.

3.3.2 Spectrometer Radium, Potassium, and Thorium Measurements

In-situ radium, potassium, and thorium concentration measurements were made at the four background locations using geoMetrics GR-410 four-channel spectrometers. The GR-410 consists of a scintillation detector and a spectrometer console with manual gain stabilization. Three single-channel analyzers provide energy windows set on particular gamma-ray energy ranges, which include the unique photopeaks of Ra, K, and Th; the fourth analyzer provides a total-count window. These units are especially useful for characterizing natural potassium and thorium concentrations, which are required to correct the delta-gamma data.

Spectrometer calibration was performed at the DOE Walker Field pads in Grand Junction, Colorado. The calibration factors necessary to convert individual-window count rates to raw concentrations of potassium, equivalent radium, and thorium were calculated from the calibration data, and are presented in Appendix A.

Two correction factors were applied to the raw concentrations of potassium, radium, and thorium. As in the treatment of the delta-gamma survey data, correction is made for soil-moisture content and for disequilibrium between radium and its radon daughters.

In the field, spectrometer-determined concentrations of potassium and thorium were used as correction factors in the conversion of raw delta counts from the delta-gamma survey to equivalent-radium concentrations. In addition, spectrometer-determined equivalent-radium concentrations were used as a direct cross-check of the delta-gamma radium measurements.

3.3.3 Soil-Moisture Correction Measurements

Soil-moisture determinations were made in the laboratory on each soil sample by calculating the loss-on-drying once constant weight was attained. In the field, each sample was placed in a plastic bag; the top of the bag was then folded twice and stapled shut to retard moisture loss.

Examination of the soil-moisture data revealed that a single constant (average) value did not apply to the entire study area. Correction factors were therefore derived from the average soil-moisture values for each peripheral area (north, south, east, and west) and each depth within each area,

together with the moisture-content values for the calibration pads. The appropriate factor was then applied to the delta-gamma-survey and spectrometer-survey data.

The soil-moisture correction factor determined from samples collected during previous radiologic surveys of the study area was applied to the delta-gamma and spectrometer measurements during the actual field survey as an approximate field-correction factor. The soil-moisture correction factors determined from all soil samples collected during the main field survey were used to correct the delta-gamma and spectrometer results presented in this report.

3.3.4 Disequilibrium Correction Measurements

The amount of disequilibrium between radium and its radon daughters was determined from laboratory analysis of soil samples collected during the orientation visit and during previous radiologic surveys of the area (Engelder and others, in preparation). The samples were processed 'as is,' without crushing or drying, and sealed in cans. Equivalent-radium concentrations were measured at 2 to 12 hours after canning, and again after 6 days. Estimates of the radon disequilibrium ratio were made by calculating the radium concentration at the time of canning and at equilibrium, using the standard equations for ingrowth and decay of the various isotopes involved (Marutzky and others, 1984; Evans, 1980; Scott and Dodd, 1960).

3.3.5 Exposure-Rate Measurements

Exposure rate is conventionally measured using a pressurized ionization chamber (PIC), which provides an accurate measurement over a wide range of energy levels. Because a PIC is not easily portable, exposure rates were measured using Mount Sopris SC-132 scintillation counters. Cross-correlation with a Reuter-Stokes RSS-111 PIC was required to account for gamma-energy spectrum changes; the resulting spectral-response correction factor was derived from correlation measurements made using the two types of instrument at the four background locations and at several points in the study area.

Exposure-rate measurements were made at waist level (a height of 1 meter) and at ground surface at each gridpoint. Between gridpoints, a walking scan was performed on the gridline, marking points exceeding 10 $\mu\text{R}/\text{h}$ above the exposure rate at the previous gridpoint. No attempt was made to define the boundaries of the contaminated area off of the gridline.

3.4 SUBSURFACE PROCEDURES

3.4.1 Drilling and Sampling Procedures

The boreholes were drilled using a portable auger powered by a gasoline engine. Auger stem diameter was 4.5 inches. As described earlier (Section 3.3.1), points having delta-gamma radium measurements greater than 5 pCi/g above background at a 12-in. depth were marked as potential borehole locations. In areas where several points were flagged, one location, believed to be representative of the area, was selected for the borehole. The holes were

drilled to a depth where geophysical logging indicated a radium concentration below 5 pCi/g, or until rocks and other debris precluded further penetration. In the latter case, several attempts to drill below the contamination were made by moving the borehole to either side of the gridpoint marker.

At most borehole locations, a sample was collected from composite auger cuttings representing drilled material from surface to total depth. These samples were used primarily for soil-moisture analysis, but were also analyzed for radium, potassium, and thorium.

3.4.2 Geophysical Borehole-Logging Procedures

The augered holes were logged using a portable gross-count system consisting of an Eberline Model PRS-1 field survey meter (RASCAL) connected by 20 ft of cable to a waterproof Eberline Model SPA-3, 2-in.-by-2-in. sodium iodide detector. The system is operated on counting plateau in a gross-count mode, which counts all gamma rays whose energies exceed approximately 30 keV.

The probe was manually lowered to the bottom of the borehole in 6-in. increments, with 30-second measurements recorded manually at each increment. The data recorded while lowering the probe were identified as 'Phase 1.' The probe was then raised to the top of the borehole, with 30-second measurements again recorded at each increment. These data were identified as 'Phase 2.'

The logging system was calibrated, both before and after the fieldwork, using the DOE borehole-calibration models at Grand Junction, Colorado, and the computer program LOGCAL (Showalter and others, 1984). Pre-fieldwork calibration was performed to process the data, while post-fieldwork calibration permitted detection of any equipment malfunctions. The resulting data were then archived in a permanent calibration data base.

The gross-count data were spatially deconvolved (George and Price, 1982) and correction was made for background concentrations of potassium and thorium to produce logs of apparent-radium concentration versus depth.

3.5 BUILDING RADIOMETRIC SURVEYS

3.5.1 Alpha Measurements in Buildings

An Eberline Air Proportional Alpha Detector (PAC-6) was used to obtain gross-alpha measurements inside the millsite buildings. Alpha measurements are useful for detecting contamination in the presence of high ambient gamma-ray fields. The former millsite buildings and foundations, currently used for warehouse space by the Bureau of Land Management (BLM), were gridded and surveyed for alpha contamination. Grid adjustments were made to ensure at least eight direct alpha measurements per room, except in very small areas. Each grid was designed to permit measurements in corners, along walls, and in the center of the floor area. If the direct alpha measurement was greater than 100 cpm, a smear was collected and counted for possible removable contamination.

3.5.2 Exposure-Rate Measurements in Buildings

Exposure rates were also measured in the buildings and on the foundations of the BLM compound, using the same grids as for the alpha survey. Measurements were performed both on the surface and at a height of one meter (waist level).

3.5.3 Delta-Gamma Measurements in Buildings

At least one delta-gamma measurement was made in each building or on each foundation at gridpoints where the exposure rate was the highest. Since the delta-gamma method reduces effects from adjacent sources of radiation, these results can be used to ascertain whether the radiation measured at a particular point can be attributed to the area that lies directly below the detector.

3.6 BACKGROUND CHARACTERIZATION

Background-measurement locations were established at four sites within a few miles of the inactive uranium millsite (cf. Figure 1). At each location, two soil samples were collected at points 50 to 75 ft apart for radium, potassium, and thorium analysis to be performed using laboratory gamma-ray-spectroscopic methods.

Prior to collecting the soil sample, radioelement concentrations were measured at the two points at each background location using a portable geoMetrics four-channel spectrometer. In-situ equivalent radium was measured using the delta-gamma systems at each soil-sampling point.

Exposure rates were measured using the pressurized ionization chamber (PIC) and each of the Mount Sopris SC-132 scintillometers that was used for exposure-rate surveys at the site. These measurements were used to correlate the scintillometer and PIC measurements (cf. Section 3.3.5), as well as to characterize background exposure rates.

3.7 VOLUME ESTIMATION

For this study, the EPA standards were used as the criteria for estimating the volume of material requiring removal. Material was considered contaminated if the Ra-226 concentration, determined from soil-sample analysis, delta-gamma measurements, and borehole-logging data, exceeded 6 pCi/g in the 6-in. surface soil layer or 16 pCi/g in any 6-in. layer beneath the surface layer. It was assumed that uncontaminated material would be removed if it were confined to a small area and surrounded by contamination, or if it were underlain by contaminated material.

All soil-sample-analysis and delta-gamma-measurement results were contoured on maps of the study area on which the millsite was outlined. The contouring technique used was the Surface II Graphics System, developed by the Kansas Geological Survey (Sampson, 1978). Contours were drawn for each 5-pCi(Ra-226)/g interval above the average background radium concentration of 1 pCi(Ra-226)/g. Areas of contamination were determined for two soil layers, from 0 to 6 in. and from 6 to 12 in. The contour map of soil-sample-analysis results for the 0-to-6-in. layer was used as a basis for mapping the surface contami-

nation. Because fewer soil-sample analyses were performed for the 6-to-12-in. layer, the contour map of the delta-gamma-measurement results was used to map contamination for that layer.

For depths greater than 12 in., the borehole-logging data were used to estimate the volume of contamination. Plate 2 is an isopachous plot of soil-sample-analysis results and borehole-logging data for each 6-in. layer evaluated in the study area.

The sizes of contaminated areas for each 6-in. layer, including the surface layer, were determined. These values were then multiplied by 6 in. to derive total-volume estimates for each layer.

4.0 RESULTS

4.1 PHYSICAL-SURVEY RESULTS

Baseline traverses were established using the four brass-capped control points around the study area (cf. Section 3.1). Since the grid is an extension of one established previously, several cross-checks were made to ensure accuracy.

The west area was originally gridded from the -2000E line using a transit and stadia rod together with line-of-sight, where possible, given the terrain and vegetation. In this area, a difference between the old and new grids was discovered, and was subsequently found to be due to an angular error of approximately 1 degree in the backsight and/or foresight. When this error was carried through a number of gridpoints, the resulting gridpoint locations differed from those on the previous grid by up to 60 ft at the northwestmost point. Because of this error, the west area of the grid between the zero and -1400N lines was resurveyed using a Theodolite and Geodimeter to obtain the true coordinates for the sampling and measurement locations.

Elevations of the augered holes were established to an accuracy of 0.1 ft, using differential leveling between benchmarks of known elevations and the five level traverses. Each traverse closed satisfactorily, the largest error being +0.28 ft in the south traverse (approximately 4000 ft in length). This error was distributed evenly throughout the traverse based on the number of setups (approximately -0.02 ft per setup). No error distribution was required for the other four traverses.

Depending on the terrain, measurement locations between surveyed gridpoints were either taped from the nearest gridpoint or paced off.

4.2 SOIL SAMPLING RESULTS

A total of 832 samples were collected and analyzed for radium, thorium, and potassium; results are presented in Appendix B, Table B-1. Duplicate analyses were performed on splits of 75 samples for all three radionuclides; radium results are presented in Appendix C, Table C-1. All but six duplicate radium-analysis results fall within reported errors (2 sigmas). Of these six, results for five samples indicate that the relative error is less than 10

percent of the mean concentration of the sample and its duplicate. One sample (MMJ-185) did not duplicate within expected errors, and reanalysis of both the sample and its split did not significantly change either value. Twenty-one samples were also analyzed for uranium and vanadium; these results are presented in Appendix B, Table B-2.

The distribution of radium-analysis results indicates that 75 percent of all samples contain greater than 5 pCi(Ra-226)/g (see Figure 3). Sample locations exhibiting greater than 6 pCi(Ra-226)/g are illustrated in Figure 4 for samples collected from the 0-to-6-in. interval and in Figure 5 for samples from the 6-to-12-in. interval. Anomalous areas seen in Figures 4 and 5 include the following:

- The ore-storage areas north, west, and south of the millsite.
- Windblown areas north, east, and south of the millsite.
- Along the irrigation ditch to the north and east of the millsite.
- Along Montezuma Creek east of the millsite.

Windblown areas to the north extend beyond the survey boundaries into residential areas. West of the site, contamination is bounded by Highway 163. To the south, contamination extends to approximately -2650N, consistent with the southern boundary of the former ore-storage area.

The mean potassium concentration for all samples above minimum detection limits is 1.7 ± 0.5 percent. The mean thorium concentration for all samples above minimum detection limits is 7 ± 2 ppm. No soil samples contain anomalous potassium or thorium concentrations.

For six of the 21 samples analyzed for uranium and vanadium (Appendix B, Table B-2), uranium/radium ratios are approximately 3.0, indicating the presence of uranium-bearing material. Of these six, only one has a high vanadium concentration. All six samples were collected in former ore-storage areas.

4.3 SURFACE RADIOMETRIC MEASUREMENT RESULTS

4.3.1 Soil-Moisture Correction Factors

Soil-moisture corrections were applied to the in-situ radium measurements to convert them to dry-weight radium concentrations. The corrections were calculated, using the moisture content of the soil, from the equation

$$F_m = 1 + 1.11[M/(1-M)] \quad (2)$$

where M is the fraction of the total weight accounted for by water (Marutzky and others, 1984).

Because calibration-pad moisture must also be taken into account, the ratio of the soil-moisture correction to the calibration-pad-moisture correction is applied to the data as follows:

$$F'_m = \frac{1 + 1.11[M_f/(1-M_f)]}{1 + 1.11[M_p/(1-M_p)]} \quad (3)$$

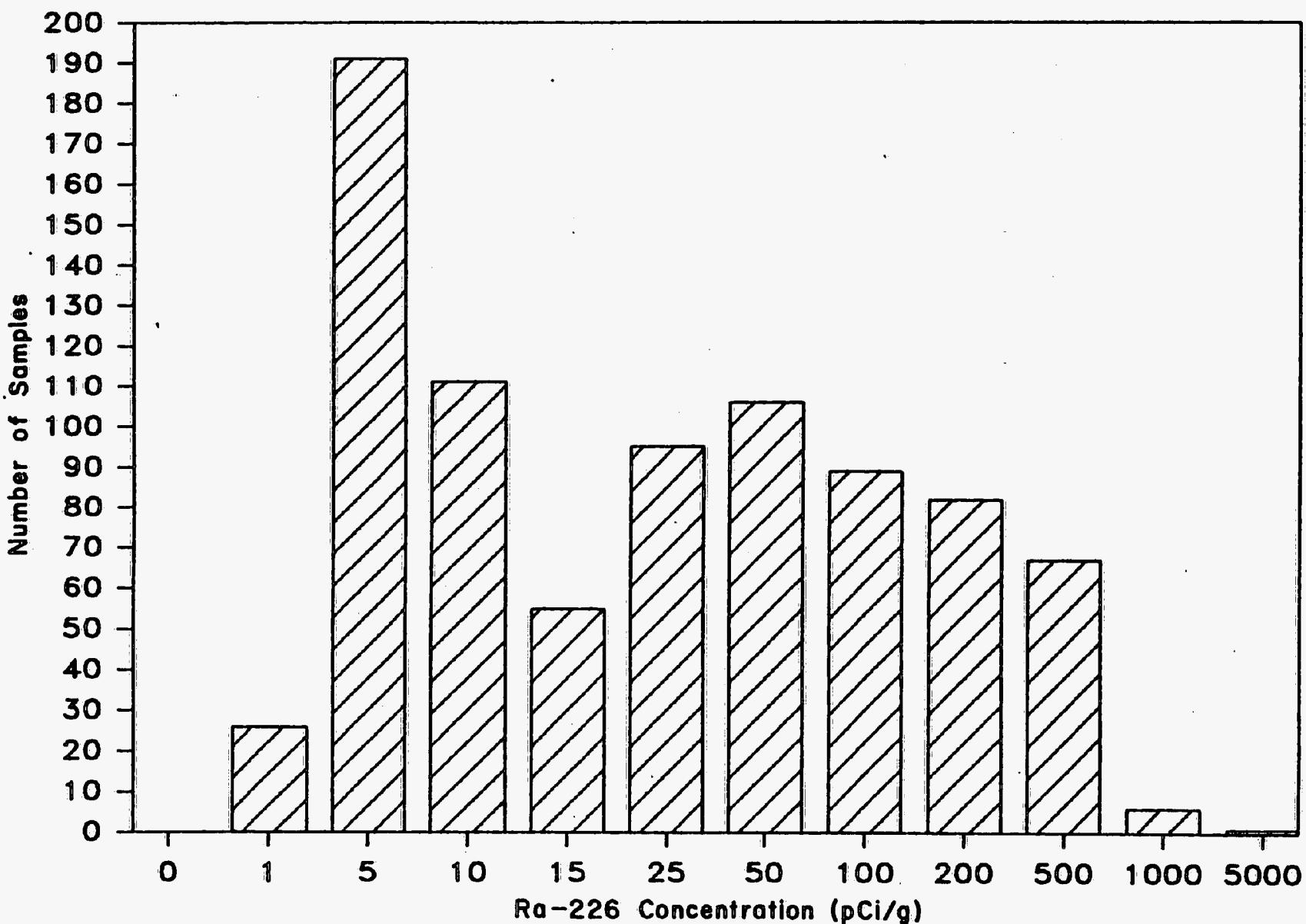


Figure 3. Histogram of Analytical Results for Ra-226 in Soils

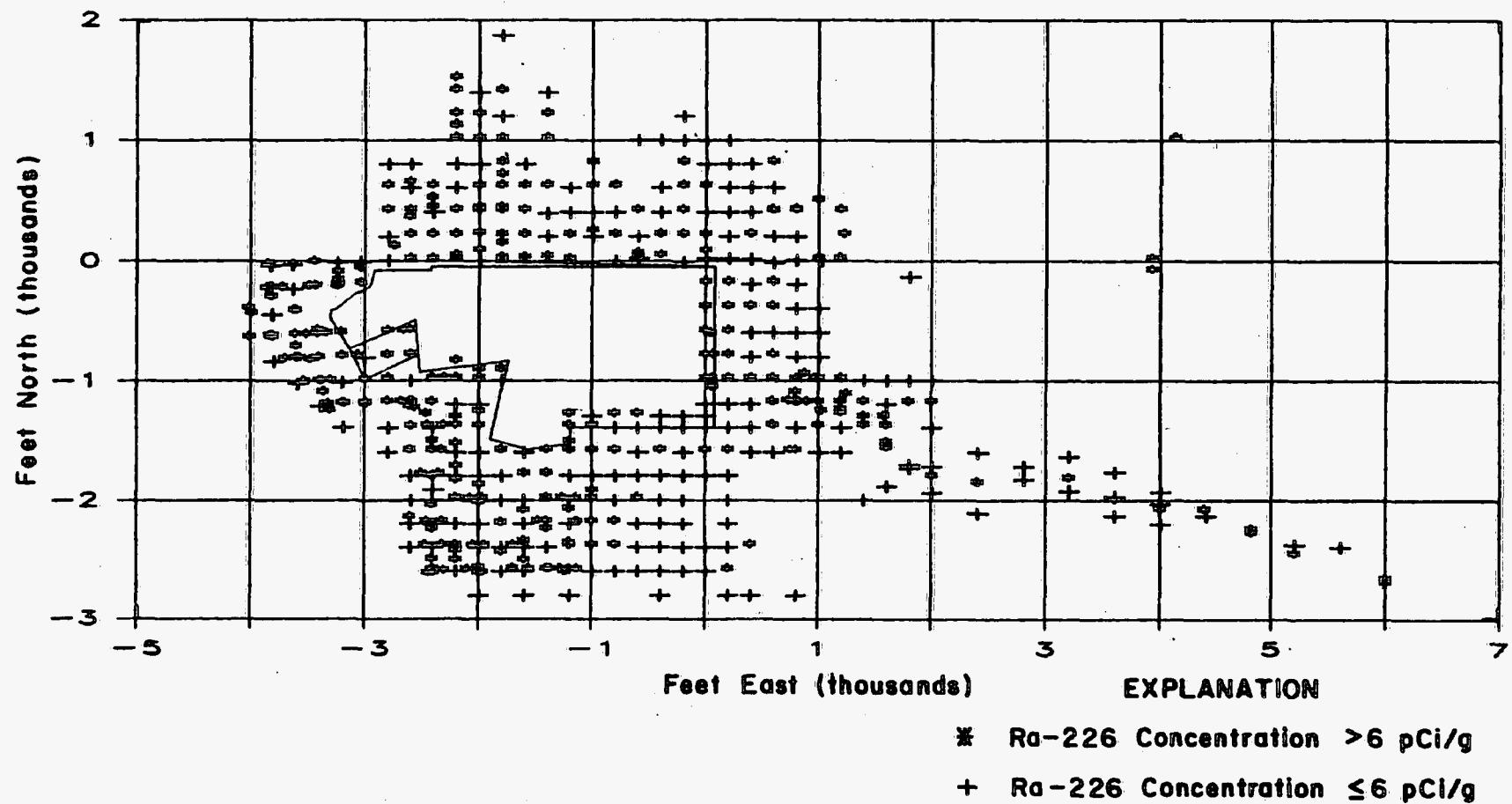
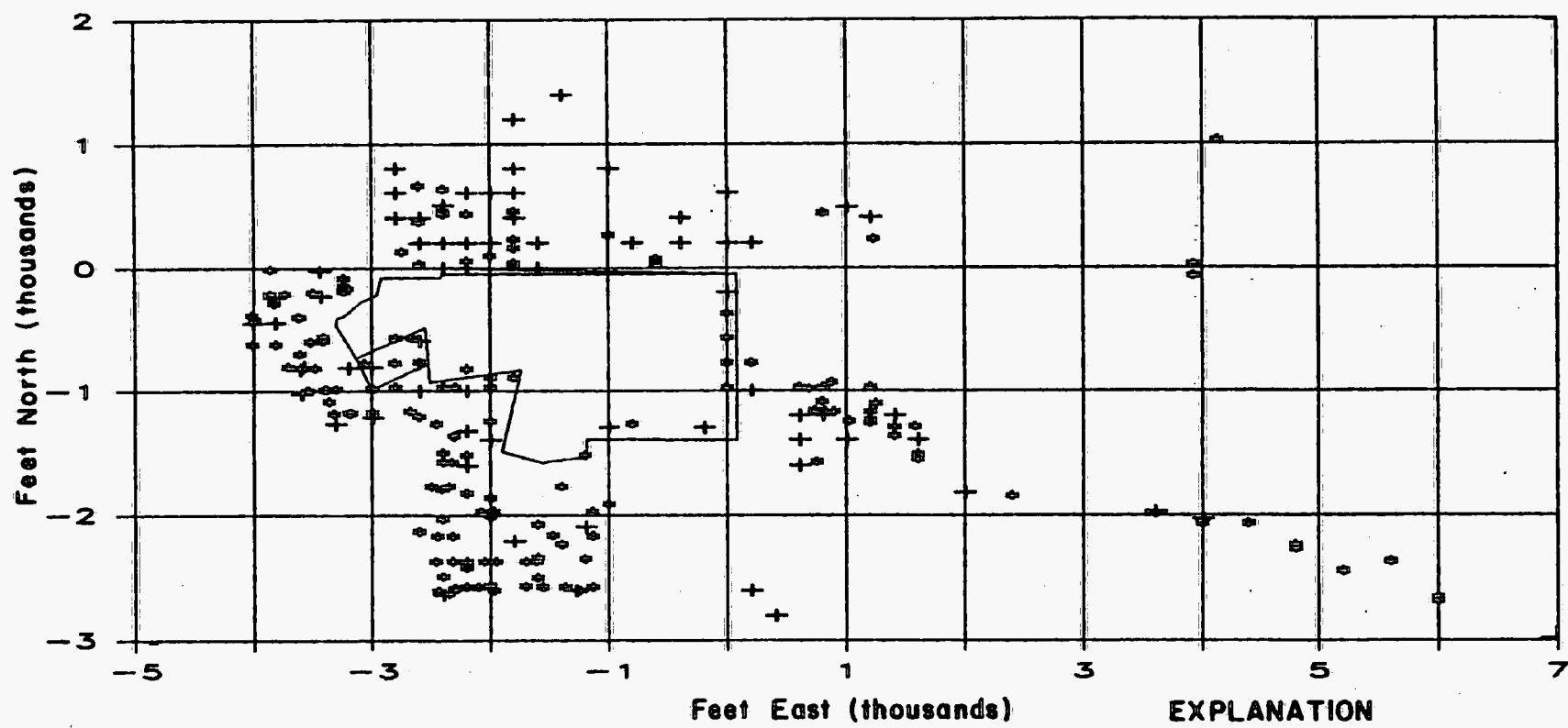


Figure 4. Locations of Soil Samples Having Ra-226 Concentrations Greater Than 6 pCi/g at Depths of 0 to 6 Inches



EXPLANATION

- * Ra-226 Concentration $> 16 \text{ pCi/g}$
- + Ra-226 Concentration $\leq 16 \text{ pCi/g}$

Figure 5. Locations of Soil Samples Having Ra-226 Concentrations Greater Than 16 pCi/g at Depths of 6 to 12 Inches

where M_f is the soil-moisture content determined for each sampling depth interval in the study area and M_p is the calibration-pad moisture content (approximately 11 percent).

Because the moisture content varied in each area and at each depth, different moisture corrections were determined and applied to the final data. Table 1 lists the moisture correction for each area and depth.

Table 1. Soil-Moisture Data for Each Area and Depth

Area	Depth (inches)	Moisture Content ^a (percent)	Moisture Correction ^a
North	0- 6	9.4 \pm 6.1	0.99 \pm 0.07
	6-12	11.0 \pm 4.3	1.00 \pm 0.05
	12-18	21.3 \pm 5.0	1.14 \pm 0.08
South	0- 6	6.3 \pm 2.4	0.94 \pm 0.03
	6-12	6.7 \pm 2.1	0.95 \pm 0.02
	12-18	9.0 \pm 5.2	0.98 \pm 0.06
East	0- 6	8.3 \pm 4.4	0.97 \pm 0.05
	6-12	7.2 \pm 3.0	0.96 \pm 0.04
	12-18	9.0 \pm 5.2	0.98 \pm 0.06
West	0- 6	5.3 \pm 3.0	0.93 \pm 0.03
	6-12	6.3 \pm 3.7	0.94 \pm 0.04
	12-18	9.0 \pm 5.2	0.98 \pm 0.06

^aAll uncertainties are one standard deviation.

4.3.2 Disequilibrium Correction Factor

Radon escaping from the soil decreases the apparent concentration of radium measured in situ because the in-situ measurement technique actually measures gamma-ray-emitting radon daughters. The amount of this decrease is the fraction of radon that escapes from the soil.

Results of laboratory measurements of disequilibrium between radium and its radon daughters in 70 samples are presented in Appendix D, Table D-1. The mean disequilibrium value (E) is 43 \pm 12 percent.

This value is within the range of disequilibrium values determined for other UMTRA sites (Allen, Showalter, and others, 1983; Allen, Steele, and others, 1983; Allen and Strong, 1984; Marutzky and others, 1983; Shay and others, 1984; Shay and Rush, 1984).

The equation used for disequilibrium correction is

$$F_e = 1/(1-E) \quad (4)$$

where F_e is the disequilibrium correction and E is the fraction of radon escaping from the soil. The apparent-radium concentration calculated from in-situ data is multiplied by the disequilibrium factor to determine actual radium concentration. Because the calibration pads also emanate radon (approximately 10 percent), the final correction applied to the field data is the ratio between the field disequilibrium correction and the calibration-pad disequilibrium correction, or

$$F'_e = \frac{1/(1-E_f)}{1/(1-E_p)} = 1.58 \pm 0.34 \quad (5)$$

where E_p is the fraction of radon escaping from the pads (10 ± 5 percent) and E_f is the fraction of radon escaping from the soil (43 ± 12 percent).

4.3.3 Delta-Gamma Radium Measurement Results

The raw data collected during the field survey were converted to equivalent-radium concentrations using correction factors for moisture, disequilibrium, and thorium and potassium concentrations, as well as the necessary calibration factors obtained from calibrations performed on the DOE Walker Field calibration pads.

The equation for data reduction is

$$C_{Ra} = F'_e [F'_m A_1 N_d / t - A_2 C_K - A_3 C_{Th}] \quad (6)$$

where C_{Ra} is the in-situ equivalent-radium concentration in pCi/g, F'_e is the disequilibrium correction factor, F'_m is the moisture correction factor, A_1 is the delta-count calibration factor for radium for the instrument used, N_d is the differential or delta count, t is the counting interval (time in seconds for the UP count), A_2 and A_3 are the potassium and thorium calibration factors, respectively, for the instrument used, and C_K and C_{Th} are the mean potassium and thorium concentrations, respectively.

The disequilibrium correction factor (F'_e) determined for this study is 1.58 (cf. Section 4.3.2). The moisture correction factor (F'_m) varies with area and depth (cf. Section 4.3.1 and Table 1).

The mean thorium and potassium concentrations for the areas around the millsite were determined from laboratory analysis of soil samples (cf. Section 4.2.1). A mean potassium concentration (C_K) of 1.7 ± 0.5 percent and a mean thorium concentration (C_{Th}) of 7 ± 2 ppm were used for reduction of the delta-gamma data. At the background locations, the mean thorium and potassium concentrations were determined from the in-situ spectrometer measurements, because the laboratory results were below detection limits. A mean potassium concentration (C_K) of 2.1 ± 0.1 percent and a mean thorium concentration (C_{Th}) of 10 ± 1.3 ppm were used to reduce the delta-gamma data at the background locations.

Uncertainties in the radium-concentration values were calculated using the equation

$$\sigma = A_1 [(2N_u - N_d)^{1/2}/t](F'_e)(F'_m) \quad (7)$$

where σ is the uncertainty in radium concentration, N_u is the unshielded or UP count, and the other parameters are as defined above. These uncertainties reflect counting errors only. Not included are the uncertainties in the apparent-radium concentration introduced by the errors associated with each correction and calibration factor. At low radium concentrations, the counting uncertainty is, most likely, the largest source of error in the measurement. At high concentrations, however, the reported counting uncertainty is likely to be overshadowed by the errors introduced by the correction- and calibration-factor uncertainties.

Figure 6 shows the correlation of sample-analysis results and delta-gamma measurements. The correlation coefficient for 304 points below 30 pCi(Ra-226)/g is 0.79. The equation for the regression has a slope of 0.86 and an offset of 0.34.

Equivalent-radium concentrations determined using the delta-gamma method, and their associated two-sigma counting uncertainties, are reported in Appendix E, Table E-1. The distribution of results from the in-situ radium measurements indicates that 65 percent of the measurements exceed 5 pCi(eRa-226)/g (see Figure 7).

Figures 8, 9, and 10 show locations where equivalent-radium concentrations greater than 6 pCi/g (5 pCi/g above background) occur in the surface, 6-in., and 12-in. layers, respectively. Contamination exceeding 6 pCi(eRa-226)/g extends beyond the study area into residential areas to the north and northwest of the millsite. To the east, contamination extends along the irrigation ditch that runs through the millsite. Contamination is present along the ditch up to the point where it appears to end in a stockpond just east of the substation (see Figure 1). Along Montezuma Creek, elevated delta-gamma measurements extend to its confluence with Vega Creek. All delta-gamma results for the east berm of Highway 163 were below 6 pCi(eRa-226)/g at the surface.

Elevated delta-gamma measurements at a 12-in. depth are generally confined to the ore-storage areas north, west, and south of the millsite, and along the irrigation ditch and Montezuma Creek.

4.3.4 Spectrometer Measurement Results

Data collected with the portable gamma-ray spectrometers (GR-410) at the four background locations were used to calculate in-situ concentrations of potassium, radium, and thorium; results are presented in Appendix F, Table F-1. The potassium and thorium values were subsequently used in the field to verify the values used to correct the delta-gamma data, while the radium values were used to cross-check the delta-gamma in-situ measurements.

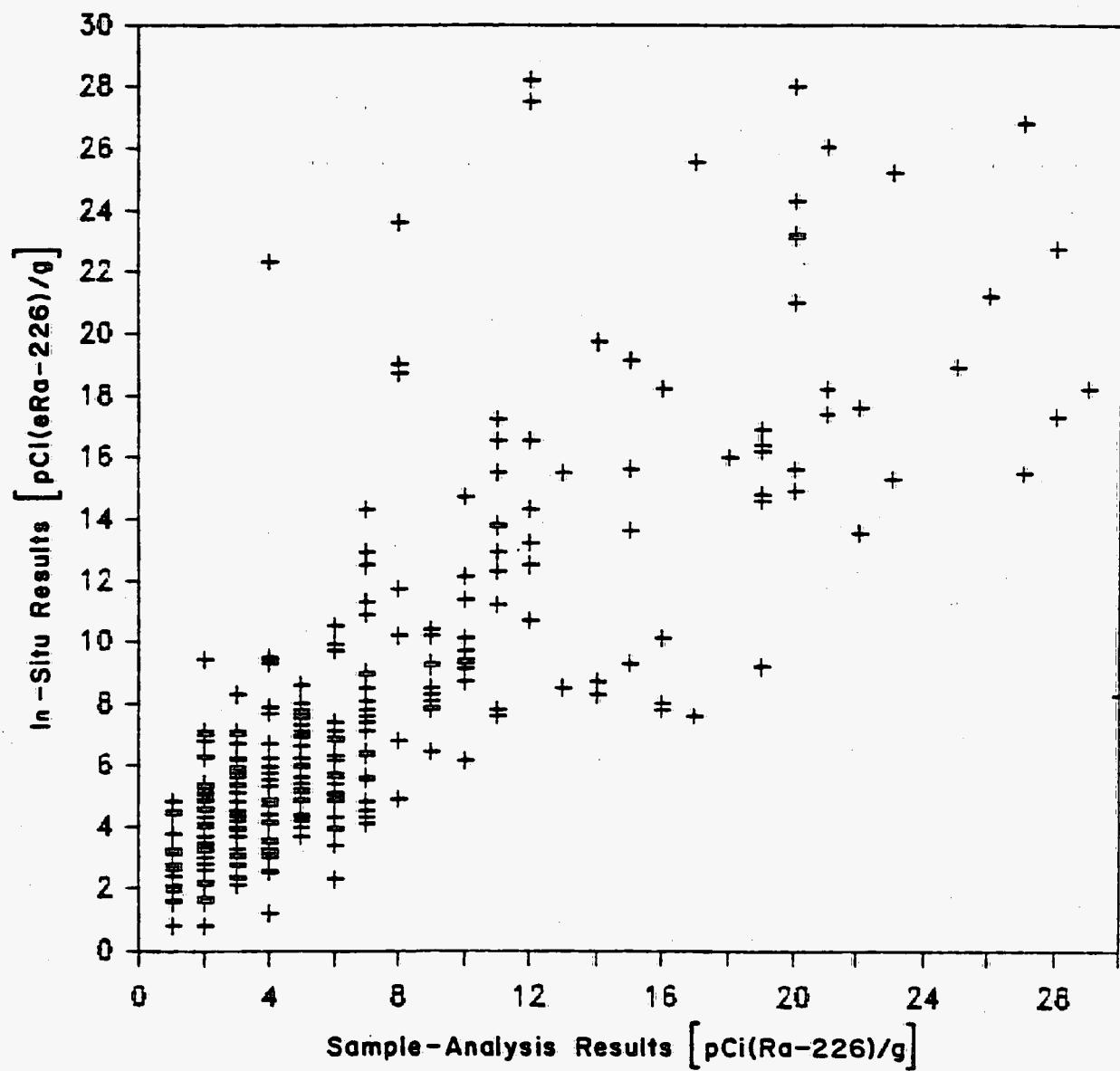


Figure 6. Scatter Plot of Soil-Sample-Analysis Results and In-Situ Measurements for Ra-226

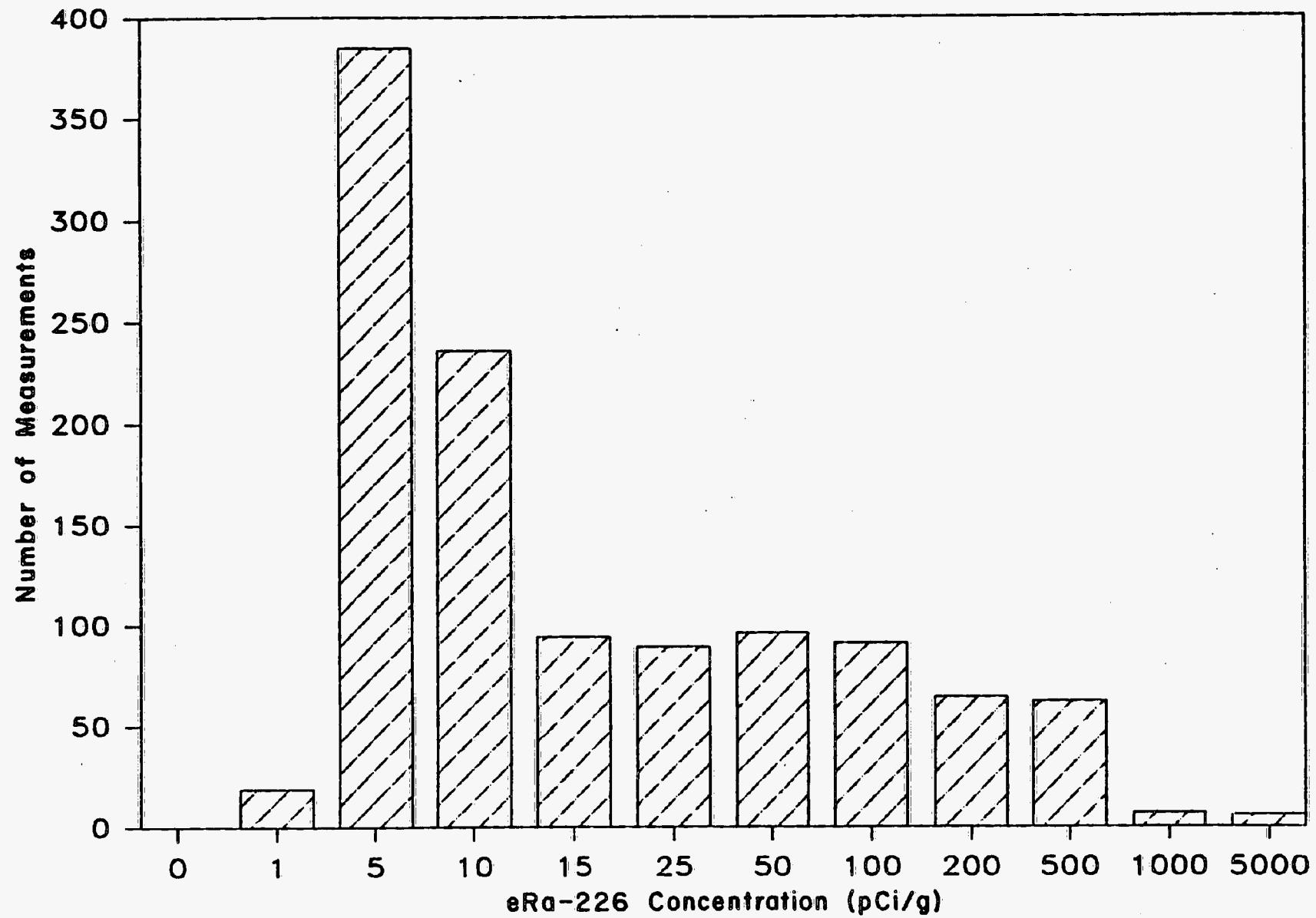


Figure 7. Histogram of Delta-Gamma Measurement Results for eRa-226

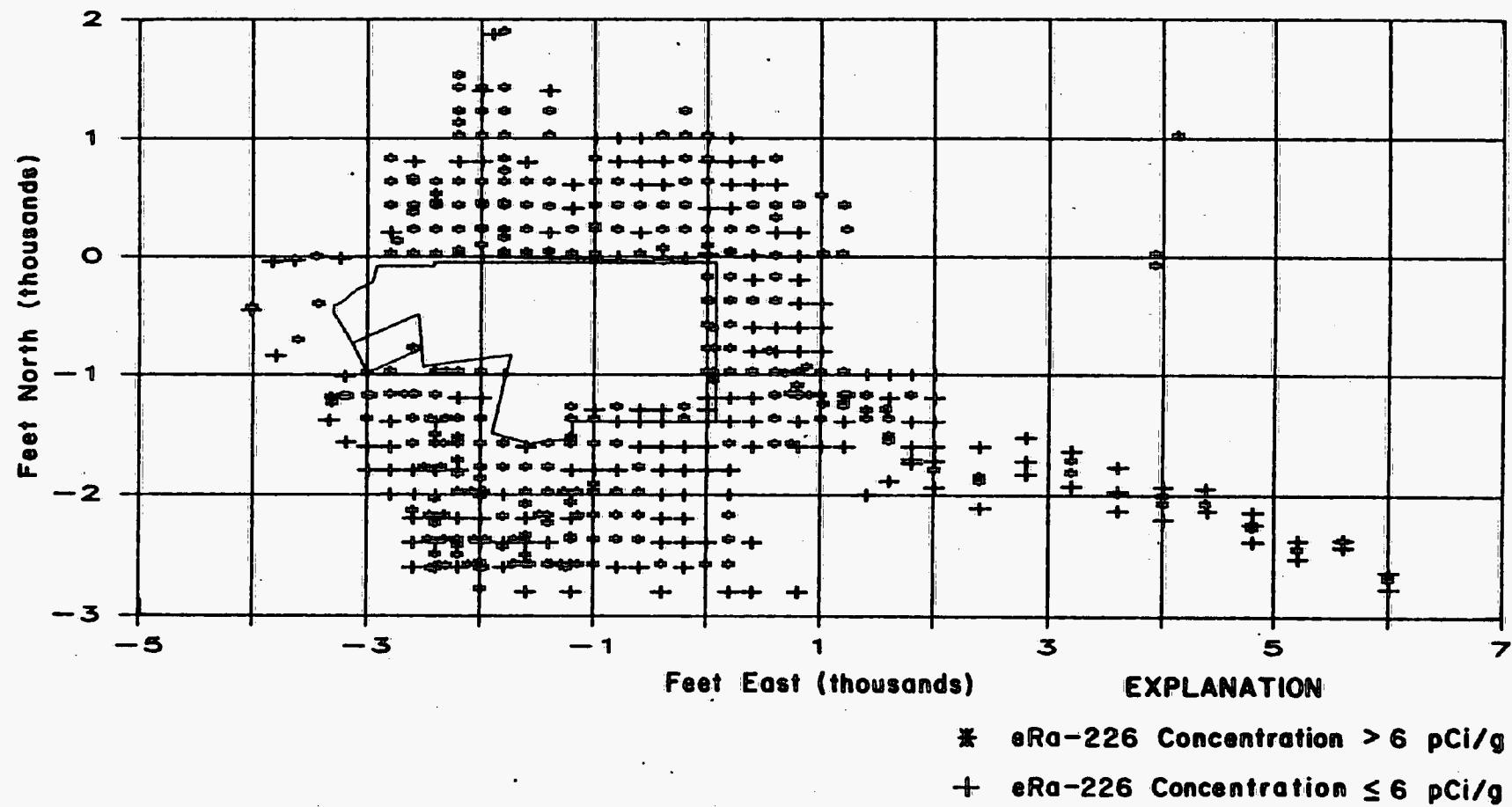


Figure 8. Locations of Delta-Gamma Measurements Greater Than 6 pCi(eRa-226)/g on the Surface Layer

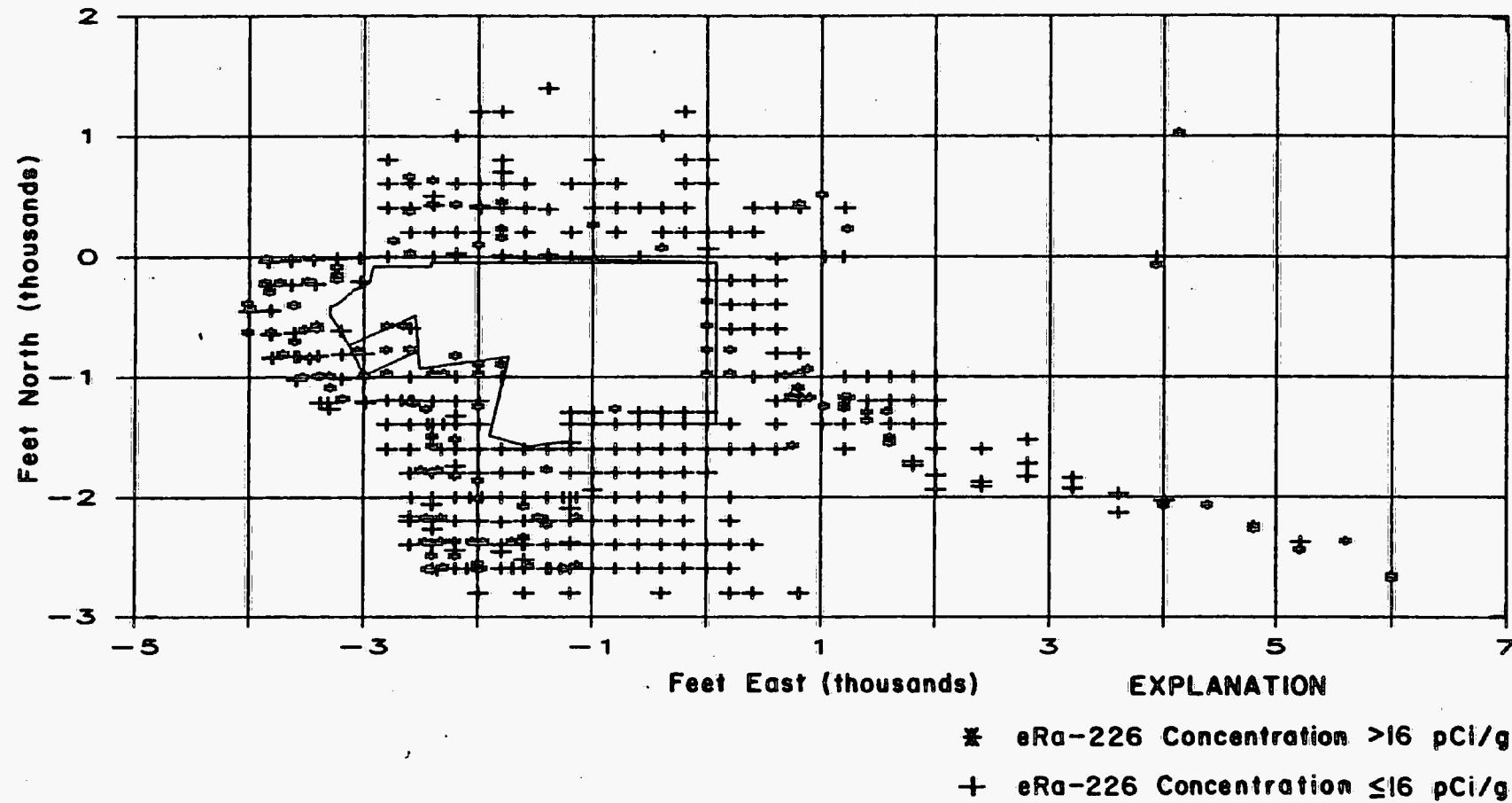


Figure 9. Locations of Delta-Gamma Measurements Greater Than 16 pCi(eRa-226)/g on the 6-Inch Layer

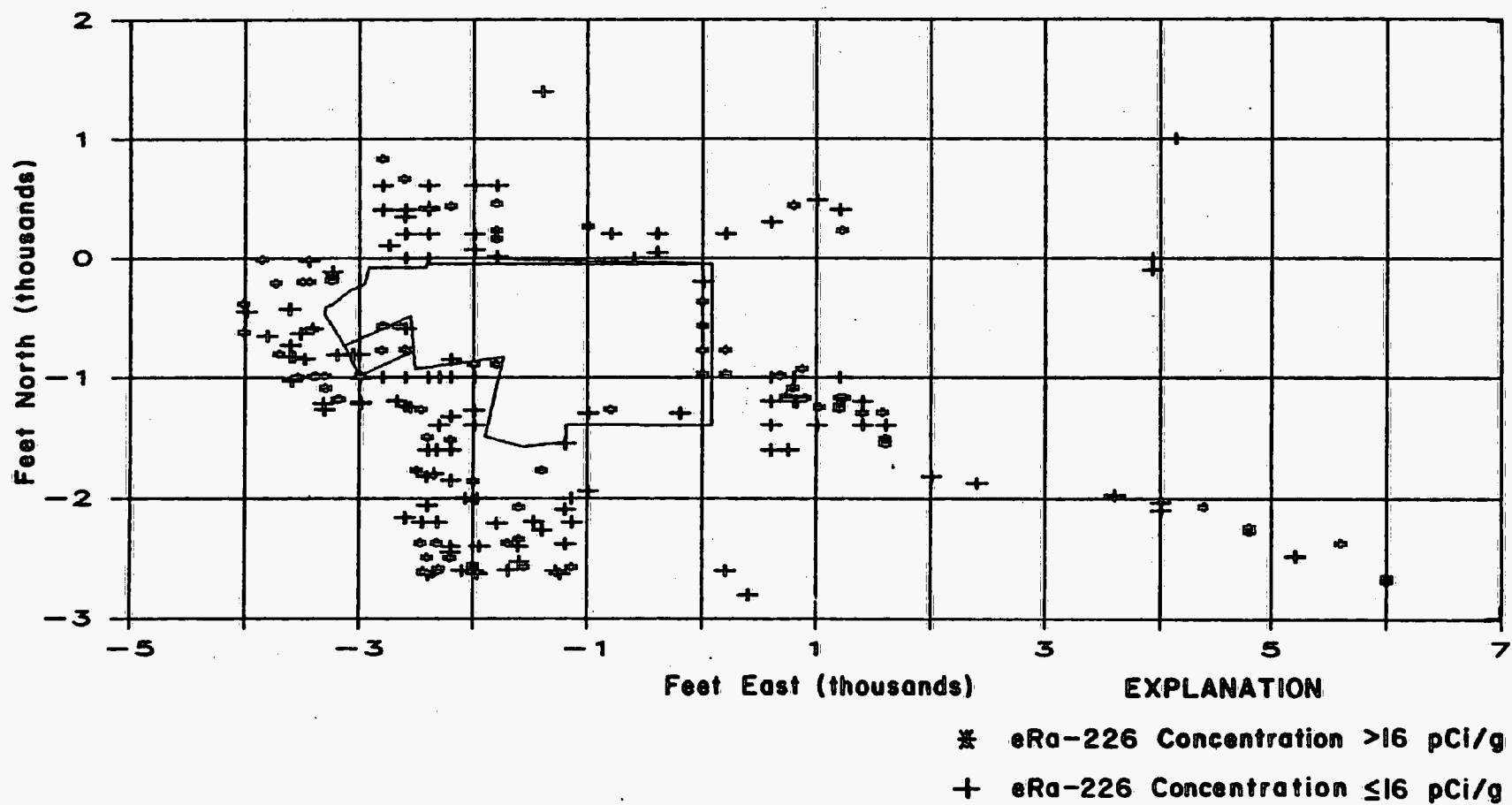


Figure 10. Locations of Delta-Gamma Measurements Greater Than 16 pCi(eRa-226)/g on the 12-Inch Layer

Calibration data were collected on the DOE Walker Field calibration pads. The data were processed through CALBRT, a computer program which performs a multiple linear regression on the data to calculate a nine-element calibration matrix which converts window count rates to equivalent radioelement concentrations.

The equations for calculating potassium, radium, and thorium concentrations, corrected for radon exhalation and moisture, are

$$\begin{aligned} C_K &= \left(a_{11}^{-1} R_K + a_{12}^{-1} R_{Ra} + a_{13}^{-1} R_{Th} \right) F'_m \\ C_{Ra} &= \left(a_{21}^{-1} R_K + a_{22}^{-1} R_{Ra} + a_{23}^{-1} R_{Th} \right) F'_m F'_e \\ C_{Th} &= \left(a_{31}^{-1} R_K + a_{32}^{-1} R_{Ra} + a_{33}^{-1} R_{Th} \right) F'_m \end{aligned} \quad (8)$$

where F'_m and F'_e are the moisture and disequilibrium corrections (cf. Sections 4.3.1 and 4.3.2).

The counting uncertainties (Stromswold and Kosanke, 1978) associated with these values are determined from the equation

$$\sigma_i = \left\{ \sqrt{\sum_{j=1}^3 \left(a_{ij}^{-1} R_j \right)^2 \left[\left(\frac{\sigma_{a_{ij}}}{a_{ij}} \right)^2 + \left(\frac{\sigma_{R_j}}{R_j} \right)^2 \right]} \right\} F'_m F'_e \quad (9)$$

Contributions from the errors associated with F'_m and F'_e to the total error in the calculation of potassium, radium, and thorium concentrations are not included in the errors reported for the spectrometer measurements.

4.3.5 Exposure-Rate Measurement Results

Exposure-rate measurements were made using Mount Sopris SC-132 scintillometers. Because these instruments respond to gamma-ray flux rather than true exposure rate, a cross-correlation with pressurized-ionization-chamber (PIC) data was performed to convert the indicated scintillometer reading to PIC exposure rate. A regression of data collected using both instruments at several locations produces an equation having the form

$$Y = A_1 + A_2(I) \quad (10)$$

where I is the indicated reading on the scintillometer in counts per second (cps), Y is the corrected exposure rate ($\mu\text{R}/\text{h}$) predicted from the scintillometer reading through correlation with the pressurized ionization chamber, and A_1 and A_2 are the coefficients determined from the regression analysis. The A_1 coefficient results primarily from exposure to cosmic rays.

A linear-least-squares regression performed on the paired PIC and scintillometer data collected in the Monticello study area provided the correlation

equation using the data from both scintillometers (see Appendix G, Figure G-1). The resulting correlation equation is

$$Y = 6.3 + 0.067(I) \quad (11)$$

The correlation coefficient for this equation is 0.99.

Results of exposure-rate measurements, made at both ground surface and waist level, are presented in Appendix G, Table G-1. Distribution of the results indicates that 45 percent of the measurement locations are at or below 20 $\mu\text{R}/\text{h}$ (see Figure 11). Locations having an exposure rate greater than 19 $\mu\text{R}/\text{h}$ (4 $\mu\text{R}/\text{h}$ above background) are shown in Figure 12. Again, the ore-storage areas, the windblown area to the north, and the areas along the irrigation ditch and Montezuma Creek exhibit elevated readings.

4.4 GEOPHYSICAL BOREHOLE-LOGGING RESULTS

The RASCAL system (cf. Section 3.4.2) was used to log 70 boreholes in the study area and 3 boreholes at the background locations. (No borehole was drilled at the West Background site because it is located on Forest Service land.) Refer to Section 3.4.1 for borehole-placement criteria.

Uncertainties in the final $\text{eRa}-226$ concentrations were calculated at the 95 percent confidence level (two standard deviations) and include terms for the following parameters:

- Statistics of the observed count rate.
- The deconvolution algorithm.
- Correction factors for borehole fluid and formation moisture.
- Calculation of background count rate due to potassium and thorium concentrations.
- The k-factor (conversion factor for total gamma-ray count rate to radium concentration) for the system.

These calculated uncertainties may be used, together with calculated concentration values, to quantify radium concentrations as being definitely below specific limits with 95 percent confidence.

Radium concentrations at or near the surface, as indicated by borehole radiometric logs, do not agree with concentrations determined from gamma-ray-spectroscopic analysis of 0-to-6-in.-deep soil samples, because the calibration procedure does not simulate the air/earth interface at the top of the borehole. The borehole-logging systems are calibrated in the middle of a zone of radioactive material assumed to appear infinitely thick and homogenous for gamma-ray generation and propagation. This same assumption is then made for the borehole when processing the log data, with appropriate deconvolution to correct for adjacent bed effects, but not near-surface and surface measurements for the air/earth interface effects.

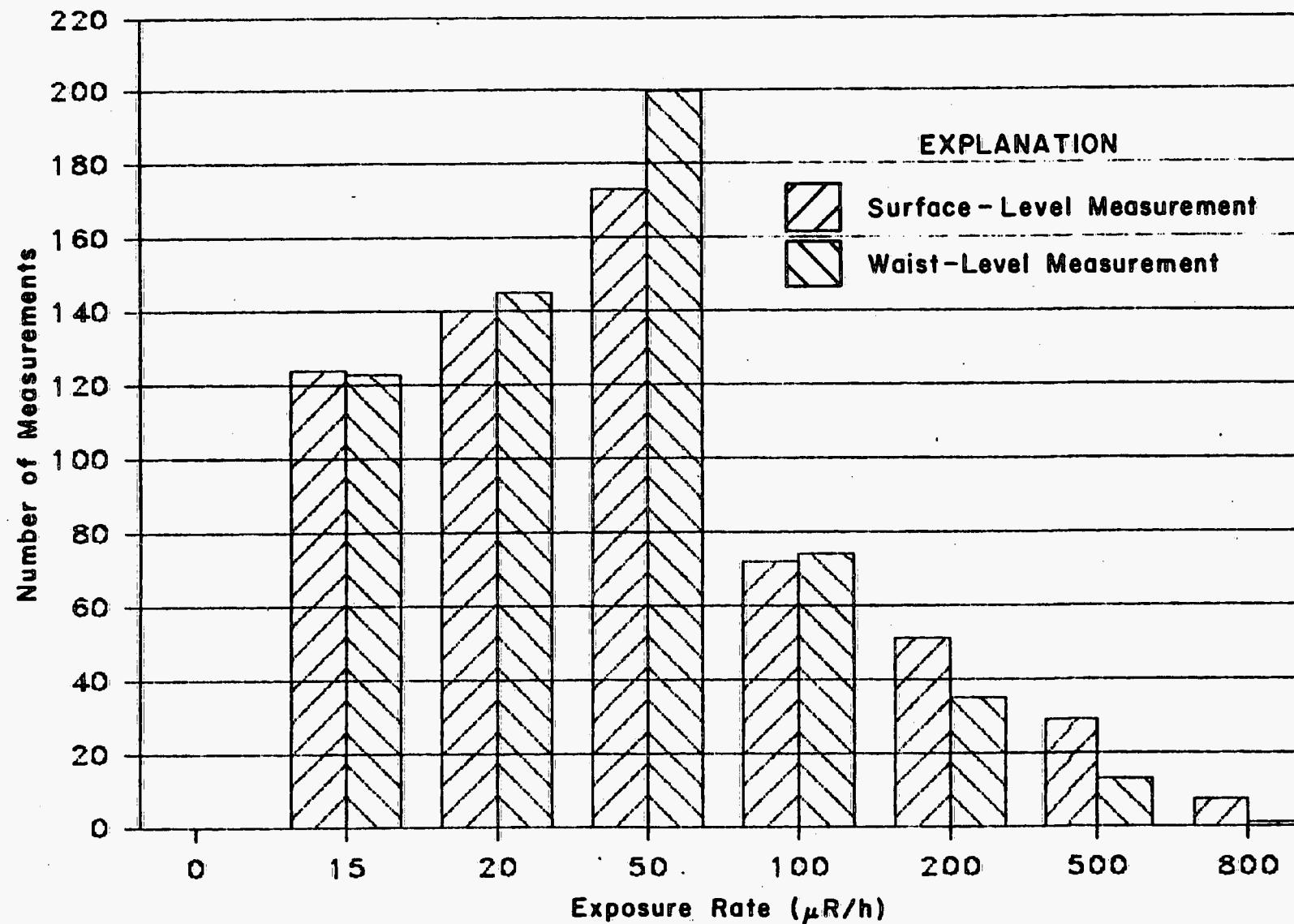
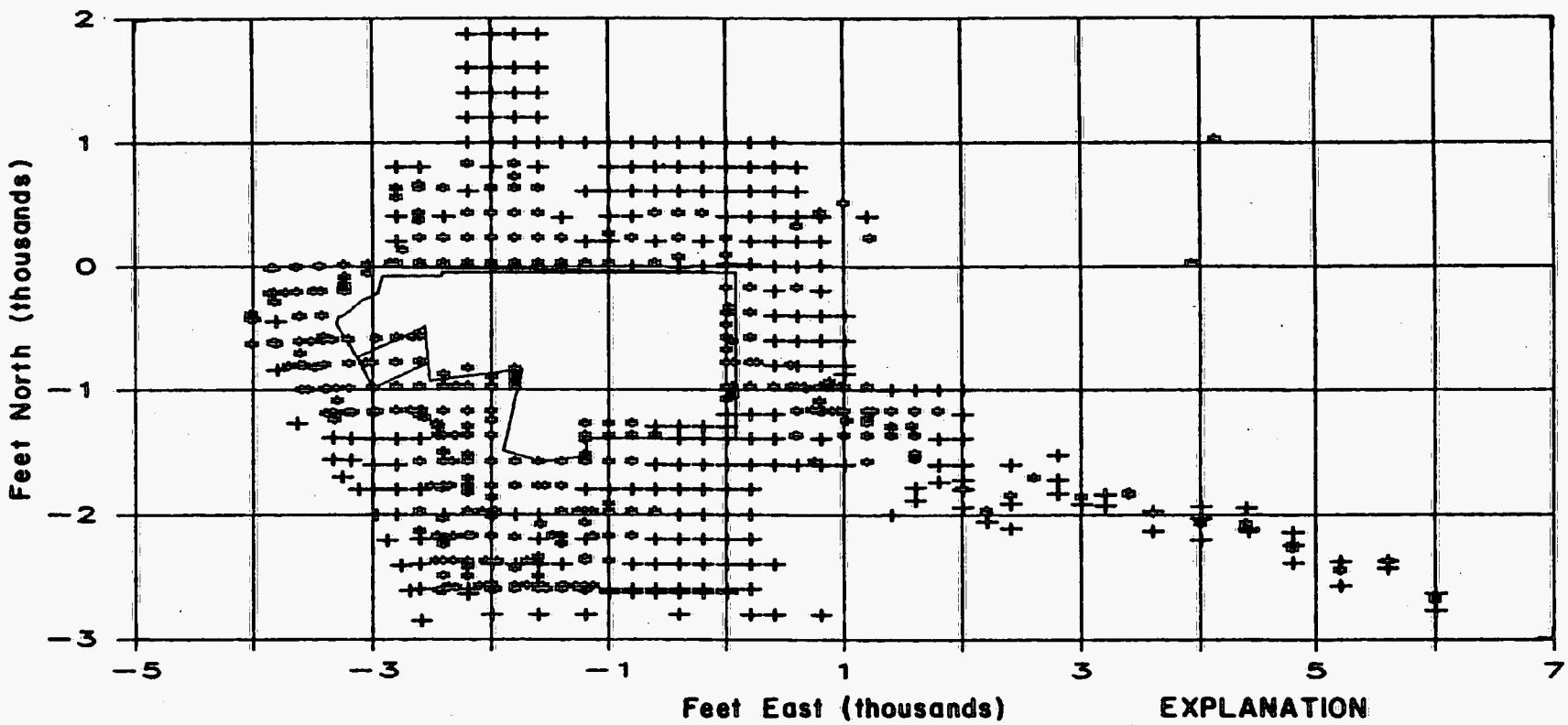


Figure 11. Histogram of Exposure-Rate Measurement Results



EXPLANATION

- * Exposure Rate $> 19 \mu\text{R}/\text{h}$
- + Exposure Rate $\leq 19 \mu\text{R}/\text{h}$

Figure 12. Locations of Exposure-Rate Measurements Greater Than $19 \mu\text{R}/\text{h}$ at the Surface

Borehole-logging and equipment data, together with the radiometric logs for each borehole, are presented in Appendix H. Each borehole was drilled until the radium concentration at the bottom of the hole was below 5 pCi/g. At several locations it was not possible to drill deep enough, usually because rocks would stop the auger. Consequently, in boreholes MON-12, 26, 37, 38, 39, 40, 48, 50, 53, 60, 65, 70, and 71, the radium concentration at total depth (TD) is still greater than 6 pCi/g.

For those boreholes in which the radium concentration at TD is below 16 pCi/g, the average depth below which the radium concentration is less than 16 pCi/g is 1.5 ft. For those boreholes in which the radium concentration at TD is below 6 pCi/g, the average depth below which the radium concentration is less than 6 pCi/g is 2 ft.

To the north, the greatest maximum depth of contamination exceeding EPA standards is 4.5 ft, encountered in borehole MON-9 at 632N, -2611E, which lies within a former ore-storage area. Borehole MON-1, located at 0N, -2400E, just outside the millsite fence, shows contamination extending to 2.0 ft. Boreholes MON-6, 10, 11, 12, and 13, located along the banks of the irrigation ditch that runs through the millsite, indicate contamination extending to 1.5 ft. All other boreholes drilled north of the millsite show contamination no deeper than 1.5 ft.

In the south ore-storage area, contamination exceeding EPA standards does not extend to depths greater than 1.0 ft, except in borehole MON-26. This hole, located at -2040N, -2000E, was drilled in a ravine thought to have been used as a dump site; contamination extends to 7.0 ft. Two boreholes (MON-25 and 28), located within 50 ft of MON-26, show contamination extending only to 0.5 ft.

Boreholes drilled west of the millsite show contamination at depths ranging from 0.5 to greater than 6.0 ft. Boreholes MON-38 and 39, located along the main road leading to the former south ore-storage area, show contamination extending beyond 6.0 ft and to 5.6 ft, respectively. Borehole MON-48, located within the BLM compound on the millsite, shows contamination extending deeper than 3.7 ft. Two other boreholes, MON-50 and 53, show contamination exceeding a depth of 2.3 ft along roads leading to former ore-storage areas. All other boreholes drilled west of the millsite show contamination extending to a depth of 2.0 ft or less.

Boreholes MON-58 through MON-71 were drilled east of the millsite on land which encompasses a stockpond. Of the two boreholes (MON-64 and 65) drilled in the stockpond, the latter shows contamination deeper than 2.5 ft. In borehole MON-63, located on the north bank of an irrigation ditch (-1600N, 749E) south of Montezuma Creek, contamination extends to 1.0 ft. Contamination in borehole MON-70 extends deeper than 4.4 ft. This hole was drilled in a small pit filled with mill tailings, situated approximately 200 ft north of Montezuma Creek; tailings from this pit have been used to bury irrigation pipes in the immediate vicinity.

All other boreholes in the area east of the millsite were drilled along Montezuma Creek. The greatest maximum depth of contamination is 3.0 ft, encountered in borehole MON-67. This hole (-1016N, 680E) is located approximately 100 ft north of the north bank of Montezuma Creek in an area

where the creek has been rerouted. As a consequence, the borehole may have been drilled through a former channel of the creek.

4.5 BUILDING RADIOMETRIC-SURVEY RESULTS

Radiometric surveys were performed in seven buildings and on seven concrete foundations and/or slabs within the BLM compound at the Monticello millsite; locations are shown in Figure I-1. All of the buildings and foundations/slabs were part of the original mill. Measurements were performed in each room in corners, along walls, and in the center of the floor area, with the grid adjusted to permit at least eight measurements per room except in very small areas such as bathrooms and walkways. Results of these radiometric surveys are presented in Figures I-2 through I-38.

4.5.1 Results of Alpha Surveys in Buildings

All buildings and foundations exhibited alpha activity above background (10 to 20 cpm). In general, the building foundations have higher activities than the buildings. Building 5 foundation had the highest activity—10000 cpm—at a point where brick chips appeared to be scattered on the surface; results on a sample collected for analysis show high radium content (7185 pCi/g). Building 12 foundation, which had been filled with either tailings or ore, had the highest average alpha activity, in excess of 200 cpm. Most smears also exhibited high activity, indicating that at least part of the contamination is removable.

4.5.2 Results of Exposure-Rate Measurements in Buildings

Each building contains at least one area where exposure rate exceeds average background. Only two buildings (7 and 10), however, had indoor exposure-rate readings higher than the EPA standard for indoor exposure rates ($20 \mu\text{R}/\text{h}$ above background). The exposure rates measured on the foundations were all above background, with the highest reading again occurring on Building 5 foundation ($140 \mu\text{R}/\text{h}$).

4.5.3 Results of Delta-Gamma Measurements in Buildings

At least one delta-gamma measurement was made in each building or on each foundation, since samples were not collected. With the exception of buildings 4, 6, 8, and 9 which had no delta-gamma results greater than $6 \text{ pCi}(\text{eRa-226})/\text{g}$, all buildings and foundations exhibited equivalent-radium concentrations exceeding 6 pCi/g . Building 12 foundation had the highest measurement, reported at $65 \text{ pCi}(\text{eRa-226})/\text{g}$.

4.6 BACKGROUND-CHARACTERIZATION RESULTS

Four locations, three within 1 to 2 miles of the millsite and one approximately 5 miles west of the millsite at the base of the Abajo Mountains, were selected for background measurements (cf. Figure 1). Results of the mea-

surements and of laboratory analyses of soil samples for each background location are presented in Appendix F, Table F-1.

The average background exposure rate, as seen by the pressurized ionization chamber, is 14.7 $\mu\text{R}/\text{h}$. The scintillometers, after cross-correlation with the PIC, yield a background exposure rate of 13 $\mu\text{R}/\text{h}$.

Analytical results on soil samples, together with results of in-situ spectrometer measurements, indicate an average background radium concentration of 1 pCi/g. The delta-gamma measurement results show an average background equivalent-radium concentration of 1.5 pCi/g, with a wide range [1.1 to 2.6 pCi($\text{eRa}-226$)]/g due to counting statistics.

Results of in-situ spectrometer measurements indicate average potassium and thorium background concentrations of 2.1 percent and 10 ppm, respectively. These values are slightly higher than the averages determined from laboratory analysis of all soil samples; however, laboratory analysis is somewhat quantitative at low concentrations.

4.7 VOLUME-ESTIMATION RESULTS

In order to meet EPA standards, an estimated 302,236 yd^3 of contaminated material must be excavated and removed from the peripheral properties in the Monticello study area (see Table 2). The weighted average depth of contamination, based on EPA criteria, is 0.9 ft over the study area. Approximately 277,984 yd^3 of the material to be removed lies adjacent to the millsite, the remainder along Montezuma Creek and the irrigation ditch north of the millsite.

Table 2. Volume of Contaminated Material Requiring Removal
Based on EPA Standards

Location	Depth Interval (ft)	Volume To Be Removed (yd^3)	
		Per Layer	Totals
Adjacent to Millsite	0 to 0.5	172,026	
	0.5 to 1.0	77,208	
	>1.0	28,750	
			SUBTOTAL <u>277,984</u>
Along Montezuma Creek	0 to 0.5	5,278	
	0.5 to 1.5	15,956	
			SUBTOTAL <u>21,234</u>
Along Irrigation Ditches			
North of Site	0 to 1.0	2,833	
Southeast of Site	0 to 1.0	185	
			SUBTOTAL <u>3,018</u>
			TOTAL <u>302,236</u>

5.0 SUMMARY

Extensive areas in and around the Monticello millsite are characterized by radium concentrations in the surface soils exceeding the EPA standard of 5 pCi(Ra-226)/g above background. This contamination has been spread by man, wind, and water.

Previous cleanup activity had brought the former ore-storage areas into compliance with earlier standards. However, the largest volume of material requiring removal to meet current standards lies within these areas to the north, west, and south of the millsite. Highway 163 bounds the contaminated area to the west. To the south, contamination extends to approximately the -2650N line, consistent with the southern boundary of the former ore-storage area. Windblown areas to the north extend into residential properties.

Montezuma Creek has carried radium contamination downstream at least two miles from the millsite to the confluence of Vega Creek. Areas characterized by radium concentrations of at least 6 pCi(Ra-226)/g are confined to the banks of Montezuma Creek east of approximately the 2000E line. West of this line, it appears that the mill tailings have been used to level the ground around the creek and to bury irrigation pipes.

The irrigation ditch that runs through the north end of the millsite has also carried contamination downstream to an area east of the electrical substation, where the ditch apparently pools into a stockpond. East of approximately 1000E, contamination occurs only in the ditch and on the banks where dredged material has been piled.

Results of the building radiometric surveys indicate that only two buildings, 7 and 10, exceed EPA indoor gamma-ray exposure-rate limits. However, radon monitoring should be implemented to determine whether other buildings exceed the working-level limits for indoor radon concentration. Foundations 3, 5, 11, and 12 exceed the EPA limit for outdoor radium concentration in soils.

The background radium concentration for the study area is 1 pCi/g. The average potassium and thorium concentrations are 1.7 percent and 7 ppm, respectively. No significant variations in concentration of these radionuclides were found within a radius of several miles of the millsite.

Decontamination to meet EPA standards will require removal of an estimated 302,236 yd³ of contaminated surface material from the peripheral properties. Approximately 278,000 yd³ of the material lies adjacent to the millsite, the remainder along Montezuma Creek and the irrigation ditch north of the millsite.

6.0 ACKNOWLEDGEMENTS

The authors wish to thank the many people who contributed to this study, in particular the land owners and BLM personnel who permitted access onto the various properties.

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Appendix A

INSTRUMENT-PERFORMANCE FIELD CHECKS AND INSTRUMENT CALIBRATIONS

Instrument-response field checks were performed on each instrument before use each day. These checks were performed at the BLM compound on the millsite in an area where the ambient radiation was near background levels.

Readings were recorded in the appropriate data book and plotted on a graph that displayed a history of previous field-check results and specified quality-control limits, which were established as two standard deviations (2σ) from the mean of the previous readings. Readings which fell outside these limits were repeated to determine if they were the result of an instrumentation problem or of the statistical probability that approximately 5 percent could be expected to fall outside these specified limits. Values used for the mean and standard deviation were based on the field-check data accumulated during the previous site characterizations.

The Mount Sopris SC-132 scintillometers were field-checked by using a special lead-lined shield box equipped with inserts to hold the instrument in a fixed geometry relative to the check source. The check sources were specially fabricated to provide near-full-scale readings on the ranges most frequently selected.

For field-checking the Mount Sopris and Bendix delta-gamma units, a calibration jig held both the detector and a uranium button source in a fixed geometry while an UP count was collected. The source was then removed to a point beyond its range of influence, and a DOWN count was collected for the same time period as the UP count. The resulting delta count rate was recorded in the appropriate data book, plotted on the graph, and checked for compliance with the 2-sigma quality-control limits.

The delta-gamma calibration jig was also used for field-checking the portable spectrometers. A 240-second background count was followed by successive 240-second counts with a uranium button source and a thorium button source. The uranium source provided test counts in the K and gross-count channels as well as in the U channel, and the thorium source provided a test of the Th channel. Background counts in each channel were subtracted from the source counts, and net count rates were recorded in the appropriate data book. Again, the count rates were plotted and checked for compliance with quality-control limits.

For field-checking the Reuter-Stokes pressurized ionization chamber (PIC), a small source-holding fixture mounted permanently to the detector housing was used. A background reading was obtained using a built-in digital stopwatch to determine the average time in seconds between two consecutive $1-\mu\text{R}$ increments of the integrator readout. Following determination of background exposure rate, a button source was placed in the source-holding fixture and the average exposure rate was again determined as above. The background rate was subtracted from this second rate to determine the net exposure rate from the source. The rate was recorded in the appropriate data book and checked for compliance with quality-control limits. To monitor PIC performance at two

different exposure levels, the procedure was repeated using 1- μ Ci and 10- μ Ci check sources.

The alpha meters were field-checked using a source designed to yield 10000 cpm above background.

The delta-gamma and spectrometer units were calibrated at the DOE calibration facility in Grand Junction prior to beginning the fieldwork (see George and Knight, 1982). The calibration pads at Walker Field Airport were used; these pads contain known concentrations of radium, potassium, and thorium mixed in various proportions. Instruments are set in the middle of each pad, and counts are collected over a certain time period. A weighted least-squares-fit of the data is performed using the program CALBRT, which was developed by Bendix. The program outputs the calibration factors in the form of a Calibration Data Sheet for each instrument (see Figures A-1 through A-6). Also included are the raw data and the radioelement concentrations of the calibration pads.

The borehole-logging units were also calibrated at the DOE calibration facility, using boreholes containing concentrations of radium, potassium and thorium mixed in various proportions. The program LOGCAL, developed by Bendix, was used to reduce the data. Calibration and correction factors are presented in Appendix H, Table H-1.

CALIBRATION DATA SHEET

PROGRAM: CALBRT V2.0

DATE CALIBRATED: 25 Jun 84

INSTRUMENT TYPE: Mount Sopris Delta

CALIBRATION MODEL NAME: Airport Pads

INSTRUMENT MODEL NUMBER: PS-872

INSTRUMENT OPERATOR: Steele

INSTRUMENT GJO NUMBER: C-1087S

REMARKS: MPPS Pre-Cals

*****COUNTS*****

PAD	GROSS COUNTS	DELTA COUNTS	TIME (SEC)
BKG	26574	3959	1800
K	69259	13787	2400
RA	82109	20973	1800
TH	65010	14736	1800
MIX	80835	19799	1800

*****CONCENTRATIONS*****

K (%)	Ra (pCi/g)	Th (ppm)
1.66 ± 0.02	0.91 ± 0.04	7.83 ± 0.25
5.80 ± 0.05	1.95 ± 0.08	9.55 ± 0.24
2.27 ± 0.02	11.87 ± 0.51	10.27 ± 0.23
2.27 ± 0.02	1.80 ± 0.06	50.28 ± 0.61
4.55 ± 0.04	7.66 ± 0.34	19.29 ± 0.33

*****CALIBRATION CONSTANTS*****

$$\begin{aligned}A_1 &= 1.25477 \pm 0.02917 \\A_2 &= 0.67768 \pm 0.03949 \\A_3 &= 0.13735 \pm 0.00624\end{aligned}$$

Figure A-1. Calibration Data Sheet for Instrument C-1087S

CALIBRATION DATA SHEET

PROGRAM: CALBRT V2.0

DATE CALIBRATED: 10 Jul 84

INSTRUMENT TYPE: Bendix Delta

CALIBRATION MODEL NAME: Airport Pads

INSTRUMENT MODEL NUMBER: EL-0018

INSTRUMENT OPERATOR: Steele

INSTRUMENT GJO NUMBER: C-1114S

REMARKS: MPPS Pre-Cals

*****COUNTS*****

PAD	GROSS COUNTS	DELTA COUNTS	TIME (SEC)
BKG	33049	3864	1800
K	65036	8252	1800
RA	115761	19468	1800
TH	90103	14166	1800
MIX	112596	18434	1800

*****CONCENTRATIONS*****

K (%)	Ra (pCi/g)	Th (ppm)
1.66 ± 0.02	0.91 ± 0.04	7.83 ± 0.25
5.80 ± 0.05	1.95 ± 0.08	9.55 ± 0.24
2.27 ± 0.02	11.87 ± 0.51	10.27 ± 0.23
2.27 ± 0.02	1.80 ± 0.06	50.28 ± 0.61
4.55 ± 0.04	7.66 ± 0.34	19.29 ± 0.33

*****CALIBRATION CONSTANTS*****

$$\begin{aligned}A_1 &= 1.30600 \pm 0.03872 \\A_2 &= 0.48050 \pm 0.05065 \\A_3 &= 0.14845 \pm 0.00806\end{aligned}$$

Figure A-2. Calibration Data Sheet for Instrument C-1114S

CALIBRATION DATA SHEET

PROGRAM: CALBRT V2.0

DATE CALIBRATED: 10 Jul 84

INSTRUMENT TYPE: Mount Sopris Delta

CALIBRATION MODEL NAME: Airport Pads

INSTRUMENT MODEL NUMBER: PS-872

INSTRUMENT OPERATOR: Steele

INSTRUMENT GJO NUMBER: C-1116S

REMARKS: MPPS Pre-Cals

*****COUNTS*****

PAD	GROSS COUNTS	DELTA COUNTS	TIME (SEC)
BKG	16688	3323	1800
K	33236	8220	1800
RA	55134	15602	1800
TH	44014	11875	1800
MIX	55136	15935	1800

*****CONCENTRATIONS*****

K (%)	Ra (pCi/g)	Th (ppm)
1.66 ± 0.02	0.91 ± 0.04	7.83 ± 0.25
5.80 ± 0.05	1.95 ± 0.08	9.55 ± 0.24
2.27 ± 0.02	11.87 ± 0.51	10.27 ± 0.23
2.27 ± 0.02	1.80 ± 0.06	50.28 ± 0.61
4.55 ± 0.04	7.66 ± 0.34	19.29 ± 0.33

*****CALIBRATION CONSTANTS*****

$$\begin{aligned}
 A_1 &= 1.70143 \pm 0.04418 \\
 A_2 &= 0.77841 \pm 0.04806 \\
 A_3 &= 0.15347 \pm 0.00717
 \end{aligned}$$

Figure A-3. Calibration Data Sheet for Instrument C-1116S

CALIBRATION DATA SHEET

PROGRAM: CALBRT V2.0

DATE CALIBRATED: 25 Jun 84

INSTRUMENT TYPE: Bendix Delta

CALIBRATION MODEL NAME: Airport Pads

INSTRUMENT MODEL NUMBER: EL-0018

INSTRUMENT OPERATOR: Steele

INSTRUMENT GJO NUMBER: C-1130S

REMARKS: MPPS Pre-Cals

*****COUNTS*****

PAD	GROSS COUNTS	DELTA COUNTS	TIME (SEC)
BKG	33987	4035	1800
K	65090	8739	1800
RA	113207	18470	1800
TH	90363	14331	1800
MIX	111275	18317	1800

*****CONCENTRATIONS*****

K (%)	Ra (pCi/g)	Th (ppm)
1.66 ± 0.02	0.91 ± 0.04	7.83 ± 0.25
5.80 ± 0.05	1.95 ± 0.08	9.55 ± 0.24
2.27 ± 0.02	11.87 ± 0.51	10.27 ± 0.23
2.27 ± 0.02	1.80 ± 0.06	50.28 ± 0.61
4.55 ± 0.04	7.66 ± 0.34	19.29 ± 0.33

*****CALIBRATION CONSTANTS*****

$$\begin{aligned}A_1 &= 1.41447 \pm 0.04507 \\A_2 &= 0.61849 \pm 0.05615 \\A_3 &= 0.16233 \pm 0.00896\end{aligned}$$

Figure A-4. Calibration Data Sheet for Instrument C-1130S

CALIBRATION DATA SHEET

PROGRAM: CALBRT V2.0

DATE CALIBRATED: 25 Jun 84

INSTRUMENT TYPE: 4-Channel Spectrometer

CALIBRATION MODEL NAME: Airport Pads INSTRUMENT MODEL NUMBER: GR-410

INSTRUMENT OPERATOR: Steele

INSTRUMENT GJO NUMBER: C-3473

REMARKS: MPPS Pre-Cals

*****COUNTS*****

PAD/PIT	K	U	TH	TIME (SEC)
BKG	25586	7154	3567	3600
K	71633	9441	4280	3600
RA	57195	35559	5241	3600
TH	43802	18884	20503	3600
MIX	76828	28802	9192	3600

*****CONCENTRATIONS*****

K (%)	Ra (pCi/g)	Th (ppm)
1.66 ± 0.02	0.91 ± 0.04	7.83 ± 0.25
5.80 ± 0.05	1.95 ± 0.08	9.55 ± 0.24
2.27 ± 0.02	11.87 ± 0.51	10.27 ± 0.23
2.27 ± 0.02	1.80 ± 0.06	50.28 ± 0.61
4.55 ± 0.04	7.66 ± 0.34	19.29 ± 0.33

*****A MATRIX*****

2.9269 ± 0.0472	0.6763 ± 0.0286	0.0637 ± 0.0029
-0.0579 ± 0.0208	0.7563 ± 0.0282	0.0620 ± 0.0019
0.0090 ± 0.0101	0.0223 ± 0.0042	0.1127 ± 0.0018

*****A INVERSE MATRIX*****

0.33581 ± 0.00573	-0.29954 ± 0.01764	-0.02528 ± 0.01399
0.02836 ± 0.00961	1.31874 ± 0.05001	-0.74104 ± 0.03802
-0.03231 ± 0.03068	-0.23663 ± 0.05746	9.02186 ± 0.14974

*****BACKGROUND CONSTANTS*****

$$\begin{aligned} K &= 1.1150 \pm 0.1389 \\ RA &= 0.9063 \pm 0.0704 \\ TH &= 0.0509 \pm 0.0510 \end{aligned}$$

Figure A-5. Calibration Data Sheet for Instrument C-3473

CALIBRATION DATA SHEET

PROGRAM: CALBRT V2.0

DATE CALIBRATED: 25 Jun 84

INSTRUMENT TYPE: 4-Channel Spectrometer

CALIBRATION MODEL NAME: Airport Pads

INSTRUMENT MODEL NUMBER: GR-410

INSTRUMENT OPERATOR: Steele

INSTRUMENT GJO NUMBER: C-3405

REMARKS: MPPS Pre-Cals

*****COUNTS*****

PAD/PIT	K	U	TH	TIME (SEC)
BKG	23214	5600	3616	3600
K	67987	9233	4551	3600
RA	54141	34893	5889	3600
TH	40868	18212	21170	3600
MIX	73159	28844	9264	3600

*****CONCENTRATIONS*****

K (%)	Ra (pCi/g)	Th (ppm)
1.66 ± 0.02	0.91 ± 0.04	7.83 ± 0.25
5.80 ± 0.05	1.95 ± 0.08	9.55 ± 0.24
2.27 ± 0.02	11.87 ± 0.51	10.27 ± 0.23
2.27 ± 0.02	1.80 ± 0.06	50.28 ± 0.61
4.55 ± 0.04	7.66 ± 0.34	19.29 ± 0.33

*****A MATRIX*****

2.8446 ± 0.0459	0.6632 ± 0.0281	0.0615 ± 0.0028
0.0259 ± 0.0211	0.7760 ± 0.0290	0.0661 ± 0.0020
0.0089 ± 0.0103	0.0324 ± 0.0041	0.1144 ± 0.0018

*****A INVERSE MATRIX*****

0.35434 ± 0.00619	-0.30221 ± 0.01838	-0.01582 ± 0.01454
-0.00970 ± 0.01034	1.32888 ± 0.05207	-0.76300 ± 0.03970
-0.02481 ± 0.03290	-0.35323 ± 0.05831	8.96117 ± 0.14972

*****BACKGROUND CONSTANTS*****

$$\begin{aligned}
 K &= 0.6230 \pm 0.1345 \\
 RA &= 0.2851 \pm 0.0699 \\
 TH &= 0.0619 \pm 0.0517
 \end{aligned}$$

Figure A-6. Calibration Data Sheet for Instrument C-3405

Appendix B

ANALYTICAL DATA FOR SOIL SAMPLES

Table B-1 presents gamma-ray-spectroscopic analytical data and Table B-2 presents radioelement data for the soil samples collected. The analytical uncertainties in the first table are reported at the two-standard-deviation (2σ) level. The MMJ numbers in the two tables are sample numbers. In Table B-1, the thorium and potassium values represent equivalent concentrations. The borehole number is included for those samples taken from boreholes. An asterisk (*) indicates that approximate coordinates were assigned to the sampling location because it falls outside the surveyed area. An exclamation point (!) in front of the radioelement concentration indicates that a secondary peak was used for analysis; a question mark (?) indicates semiquantitative analysis; and a less-than sign (<) indicates that the minimum detection limit was reached based on Compton background.

Table B-1

Gamma-Ray-Spectroscopy Data for Soil Samples

Grid <u>Coordinates</u> North East	Depth (in.)	Bore- hole No.	MMJ No.	Concentration			
				Ra-226 (pCi/g)	Thorium (ppm)	Potassium (%)	
-33924*	20338*	0- 6	0	880	1 ± 1	! 7 ± 2	1.2 ± 0.3
-33924*	20328*	0- 6	0	846	? 1 ± 1	? 2 ± 1	? 0.6 ± 0.1
-4870*	13000*	0- 6	0	844	37 ± 2	? 7 ± 2	? 1.5 ± 0.2
-4870*	13000*	6-12	0	845	63 ± 3	? 5 ± 1	? 1.0 ± 0.2
-4670*	13120*	0- 6	0	879	1 ± 1	< 2	1.3 ± 0.3
-3250*	11760*	0- 6	0	841	12 ± 1	? 8 ± 2	? 1.3 ± 0.2
-3250*	11760*	6-12	0	842	25 ± 1	? 3 ± 1	? 1.2 ± 0.2
-3250*	11760*	12-18	0	843	31 ± 2	? 9 ± 2	? 1.5 ± 0.2
-3050*	11670*	0- 6	0	878	1 ± 1	< 2	? 0.8 ± 0.2
-2800	200	0- 6	0	556	2 ± 1	? 9 ± 2	? 1.8 ± 0.3
-2800	400	0- 6	0	559	2 ± 1	? 6 ± 2	? 2.2 ± 0.3
-2800	400	6-12	0	560	2 ± 1	? 7 ± 2	? 2.3 ± 0.3
-2800	800	0- 6	0	561	3 ± 1	? 2 ± 1	? 2.1 ± 0.3
-2800	-400	0- 6	0	535	3 ± 1	! 8 ± 2	2.1 ± 0.5
-2800	-1200	0- 6	0	534	3 ± 1	? 8 ± 2	2.6 ± 0.2
-2800	-1600	0- 6	0	533	2 ± 1	? 8 ± 2	2.9 ± 0.3
-2800	-2000	0- 6	0	149	5 ± 1	? 5 ± 1	? 1.9 ± 0.3
-2716	6000	0- 6	0	836	130 ± 6	? 2 ± 1	? 1.2 ± 0.2
-2716	6000	6-12	0	837	182 ± 9	? 5 ± 1	? 0.8 ± 0.1
-2716	6000	12-18	0	838	322 ± 16	? 1 ± 1	? 1.4 ± 0.3
-2681	6000	0- 6	0	834	184 ± 7	? 2 ± 1	? 1.1 ± 0.2
-2681	6000	6-12	0	835	213 ± 9	? 3 ± 1	? 1.4 ± 0.2
-2635	-2400	0- 6	0	123	63 ± 4	< 4	? 1.3 ± 0.3
-2635	-2400	6-12	0	124	13 ± 1	< 3	1.4 ± 0.4
-2635	-2440	0-45	14	297	26 ± 1	? 6 ± 2	? 1.8 ± 0.3
-2635	-2440	0- 6	0	388	151 ± 7	< 4	2.2 ± 0.3

Table B-1 (continued)

Grid <u>Coordinates</u>		Bore- hole No.	MMJ No.	Concentration			
North	East	Depth (in.)		Ra-226 (pCi/g)	Thorium (ppm)	Potassium (%)	
-2635	-2440	6-12	0	395	174 ± 9	< 5	1.8 ± 0.5
-2632	-2000	0- 6	0	387	205 ± 7	< 4	2.7 ± 0.3
-2632	-2000	0- 6	0	400	245 ± 11	< 6	2.1 ± 0.6
-2630	-1245	0- 6	0	307	332 ± 15	? 6 ± 2	? 1.9 ± 0.3
-2630	-1245	6-12	0	310	69 ± 3	< 4	1.4 ± 0.4
-2630	-1970	0-36	30	605	137 ± 8	< 4	2.2 ± 0.3
-2630	-1970	0- 6	0	177	5763 ± 265	< 26	< 1.5
-2630	-1970	6-12	0	532	58 ± 3	? 6 ± 2	2.6 ± 0.3
-2610	-2300	0- 6	0	393	249 ± 14	< 5	0.7 ± 0.3
-2610	-2300	0-48	16	299	36 ± 2	? 10 ± 2	? 1.5 ± 0.2
-2610	-2300	6-12	0	502	255 ± 19	< 5	< 0.6
-2610	-2359	0- 6	0	125	62 ± 3	< 4	1.9 ± 0.5
-2610	-2359	6-12	0	126	5 ± 1	< 2	1.3 ± 0.3
-2600	0	0- 6	0	384	6 ± 1	? 6 ± 1	2.6 ± 0.2
-2600	200	0- 6	0	551	11 ± 1	? 5 ± 2	? 2.1 ± 0.3
-2600	200	6-12	0	552	12 ± 1	? 7 ± 2	? 1.9 ± 0.3
-2600	-200	0- 6	0	379	6 ± 1	? 9 ± 2	2.6 ± 0.2
-2600	-400	0- 6	0	366	5 ± 1	< 2	1.9 ± 0.4
-2600	-600	0- 6	0	359	5 ± 1	< 2	1.8 ± 0.4
-2600	-800	0- 6	0	356	4 ± 1	< 2	1.7 ± 0.4
-2600	-1000	0- 6	0	347	6 ± 1	? 8 ± 2	2.5 ± 0.2
-2600	-1135	0- 6	0	346	85 ± 3	< 3	2.4 ± 0.3
-2600	-1135	6-12	0	357	339 ± 21	< 7	< 0.7
-2600	-1200	0- 6	0	311	7 ± 1	< 2	1.3 ± 0.3
-2600	-1280	0- 6	0	308	88 ± 5	? 6 ± 2	? 1.9 ± 0.3
-2600	-1280	6-12	0	312	15 ± 1	< 3	1.6 ± 0.4
-2600	-1370	0- 6	0	306	199 ± 11	< 10	? 1.8 ± 0.3
-2600	-1370	6-12	0	309	60 ± 3	< 4	? 1.3 ± 0.4
-2600	-1400	0- 6	0	305	8 ± 1	? 7 ± 2	? 2.3 ± 0.3
-2600	-1555	0-42	19	651	16 ± 1	? 8 ± 2	? 1.9 ± 0.2
-2600	-1555	0- 6	0	193	418 ± 28	< 5	2.2 ± 0.3
-2600	-1555	6-12	0	303	409 ± 21	? 7 ± 2	? 1.4 ± 0.3
-2600	-1600	0- 6	0	192	4 ± 1	? 8 ± 2	2.8 ± 0.3
-2600	-1800	0- 6	0	175	2 ± 1	< 2	1.4 ± 0.4
-2600	-2000	0- 6	0	145	18 ± 1	? 7 ± 2	? 1.5 ± 0.2
-2600	-2000	6-12	0	147	19 ± 1	? 9 ± 2	? 1.7 ± 0.2
-2600	-2100	0- 6	0	394	65 ± 4	< 3	1.7 ± 0.4
-2600	-2100	6-12	0	501	17 ± 1	< 2	1.5 ± 0.4
-2600	-2200	0- 6	0	143	? 1 ± 1	? 8 ± 2	? 1.8 ± 0.2
-2600	-2200	6-12	0	144	126 ± 8	? 1 ± 1	? 1.7 ± 0.3
-2600	-2400	0- 6	0	122	7 ± 1	< 2	1.6 ± 0.4
-2595	-1700	0- 6	0	176	354 ± 26	< 7	< 0.7
-2595	-1700	6-12	0	178	52 ± 3	< 4	? 1.1 ± 0.3
-2586	-1135	0-45	22	655	45 ± 2	? 9 ± 2	? 1.7 ± 0.2
-2583	-2000	0-44	29	604	17 ± 1	? 6 ± 2	2.1 ± 0.2
-2583	-2000	0- 6	0	146	184 ± 11	? 5 ± 2	? 1.9 ± 0.3
-2583	-2000	6-12	0	148	177 ± 10	? 6 ± 2	? 1.6 ± 0.3

Table B-1 (continued)

Grid Coordinates		Depth (in.)	Bore- hole No.	MMJ No.	Concentration					
North	East				Ra-226 (pCi/g)	Thorium (ppm)	Potassium (%)			
-2525	-2200	0-39	17	652	16 ± 1	? 5 ± 1	? 1.8 ± 0.2			
-2525	-2200	0- 6	0	142	81 ± 6	? 3 ± 1	? 1.6 ± 0.3			
-2523	-1600	0- 6	0	191	105 ± 6	< 3	2.8 ± 0.3			
-2523	-1600	6-12	0	301	35 ± 2	? 2 ± 1	? 2.0 ± 0.3			
-2518	-2400	0- 6	0	119	83 ± 4	< 4	1.6 ± 0.4			
-2518	-2400	0-39	15	298	39 ± 2	< 8	? 1.7 ± 0.2			
-2518	-2400	6-12	0	120	139 ± 8	? 5 ± 2	? 2.2 ± 0.3			
-2518	-2400	12-18	0	121	38 ± 2	< 3	< 0.6			
-2478	5200	0- 6	0	851	11 ± 1	? 7 ± 2	? 1.8 ± 0.3			
-2478	5200	6-12	0	852	32 ± 2	< 8	? 1.5 ± 0.2			
-2460	-1800	0- 6	0	171	42 ± 2	< 4	1.5 ± 0.4			
-2450	-2200	0- 6	0	140	113 ± 5	? 11 ± 3	? 1.9 ± 0.3			
-2450	-2200	6-12	0	141	19 ± 1	? 7 ± 2	? 1.8 ± 0.2			
-2402	5600	0- 6	0	832	4 ± 1	? 10 ± 2	? 2.0 ± 0.2			
-2402	5600	6-12	0	833	17 ± 1	? 6 ± 2	? 1.4 ± 0.2			
-2400	0	0- 6	0	383	5 ± 1	? 7 ± 2	2.5 ± 0.2			
-2400	200	0- 6	0	562	3 ± 1	? 3 ± 1	? 2.1 ± 0.3			
-2400	400	0- 6	0	563	7 ± 1	< 2	2.0 ± 0.5			
-2400	-200	0- 6	0	378	5 ± 1	? 5 ± 2	2.5 ± 0.3			
-2400	-400	0- 6	0	367	3 ± 1	? 9 ± 3	1.7 ± 0.4			
-2400	-600	0- 6	0	360	2 ± 1	< 2	1.5 ± 0.4			
-2400	-800	0- 6	0	355	7 ± 1	< 3	? 1.3 ± 0.3			
-2400	-1000	0- 6	0	345	16 ± 1	< 2	1.8 ± 0.5			
-2400	-1200	0- 6	0	313	31 ± 2	< 3	1.5 ± 0.4			
-2400	-1400	0- 6	0	304	2 ± 1	? 14 ± 3	? 1.8 ± 0.2			
-2400	-1600	0- 6	0	188	1 ± 1	? 8 ± 1	2.4 ± 0.2			
-2400	-1614	0- 6	0	189	159 ± 10	< 4	1.9 ± 0.3			
-2400	-1614	6-12	0	195	62 ± 3	< 3	2.1 ± 0.2			
-2400	-1700	0-39	21	654	22 ± 1	? 5 ± 1	? 2.2 ± 0.3			
-2400	-1700	0- 6	0	185	181 ± 7	< 4	2.7 ± 0.3			
-2400	-1700	6-12	0	302	292 ± 12	? 3 ± 1	? 1.7 ± 0.3			
-2400	-1800	0- 6	0	170	2 ± 1	? 8 ± 2	1.6 ± 0.4			
-2400	-1954	0- 6	0	173	116 ± 7	< 5	1.4 ± 0.4			
-2400	-1954	6-12	0	174	92 ± 5	< 4	? 1.3 ± 0.4			
-2400	-2000	0- 6	0	151	1 ± 1	< 2	1.3 ± 0.3			
-2400	-2050	0- 6	0	385	12 ± 1	? 6 ± 2	2.9 ± 0.3			
-2400	-2050	6-12	0	503	64 ± 3	< 4	1.6 ± 0.4			
-2400	-2200	0- 6	0	138	74 ± 4	< 4	? 1.2 ± 0.3			
-2400	-2200	6-12	0	139	58 ± 3	< 4	1.5 ± 0.4			
-2400	-2320	0-54	18	300	13 ± 1	? 7 ± 2	? 1.9 ± 0.3			
-2400	-2320	0- 6	0	386	267 ± 14	< 4	2.2 ± 0.3			
-2400	-2320	6-12	0	504	235 ± 13	< 5	< 0.7			
-2400	-2400	0- 6	0	118	6 ± 1	? 12 ± 3	1.8 ± 0.4			
-2400	-2460	0- 6	0	389	596 ± 37	< 5	? 1.2 ± 0.3			
-2400	-2460	6-12	0	505	550 ± 32	< 7	< 0.8			
-2400	-2600	0- 6	0	528	3 ± 1	? 9 ± 1	2.2 ± 0.2			
-2379	-1200	0- 6	0	314	84 ± 5	< 4	? 1.2 ± 0.3			

Table B-1 (continued)

Grid <u>Coordinates</u>		Bore- hole No.	MMJ No.	Concentration			
North	East	Depth (in.)		Ra-226 (pCi/g)	Thorium (ppm)	Potassium (%)	
-2379	-1200	6-12	0	358	22 ± 1	< 3	1.5 ± 0.4
-2378	5200	0- 6	0	831	3 ± 1	? 10 ± 2	3.1 ± 0.3
-2369	-1600	0-30	20	653	11 ± 1	? 6 ± 2	? 1.5 ± 0.2
-2369	-1600	0- 6	0	187	685 ± 38	< 6	? 1.4 ± 0.3
-2369	-1600	6-12	0	194	196 ± 10	< 4	2.1 ± 0.3
-2304	4800	0- 6	0	840	21 ± 1	? 4 ± 1	? 1.4 ± 0.2
-2304	4800	6-12	0	839	130 ± 6	? 5 ± 1	? 1.6 ± 0.2
-2271	-2400	0- 6	0	117	88 ± 4	< 4	2.1 ± 0.5
-2270	4800	0- 6	0	800	98 ± 4	? 7 ± 2	? 1.6 ± 0.2
-2270	4800	6-12	0	830	139 ± 6	< 4	? 1.4 ± 0.2
-2261	-1400	0- 6	0	200	142 ± 7	< 9	? 1.9 ± 0.3
-2261	-1400	6-12	0	327	81 ± 4	< 4	1.8 ± 0.5
-2207	-1800	0- 6	0	169	41 ± 2	< 4	? 0.9 ± 0.3
-2207	-1800	6-12	0	172	15 ± 1	< 3	? 1.3 ± 0.4
-2202	4000	0- 6	0	771	? 1 ± 1	? 5 ± 2	2.1 ± 0.5
-2200	200	0- 6	0	564	5 ± 1	! 8 ± 3	2.0 ± 0.5
-2200	-200	0- 6	0	377	3 ± 1	? 8 ± 1	2.7 ± 0.2
-2200	-400	0- 6	0	368	5 ± 1	< 2	1.6 ± 0.4
-2200	-600	0- 6	0	361	5 ± 1	< 2	1.3 ± 0.3
-2200	-800	0- 6	0	354	16 ± 1	< 3	2.1 ± 0.5
-2200	-1000	0- 6	0	344	30 ± 2	7 ± 4	1.8 ± 0.5
-2200	-1140	0- 6	0	316	193 ± 12	< 5	< 0.7
-2200	-1140	6-12	0	335	155 ± 7	< 5	1.3 ± 0.4
-2200	-1200	0- 6	0	315	1 ± 1	< 2	1.7 ± 0.4
-2200	-1400	0- 6	0	199	9 ± 1	? 3 ± 1	? 1.5 ± 0.2
-2200	-1600	0- 6	0	183	6 ± 1	? 9 ± 2	2.1 ± 0.2
-2200	-2000	0- 6	0	152	3 ± 1	< 2	1.9 ± 0.4
-2200	-2200	0- 6	0	137	6 ± 1	< 2	1.7 ± 0.4
-2200	-2325	0- 6	0	390	100 ± 5	< 4	1.8 ± 0.5
-2200	-2325	6-12	0	507	76 ± 4	< 4	1.5 ± 0.4
-2200	-2400	0- 6	0	116	2 ± 1	! 9 ± 3	1.9 ± 0.4
-2200	-2452	0- 6	0	391	192 ± 10	< 5	1.1 ± 0.4
-2200	-2452	6-12	0	506	126 ± 7	< 4	? 1.1 ± 0.3
-2200	-2600	0- 6	0	527	5 ± 1	? 7 ± 2	2.8 ± 0.3
-2195	-1475	0- 6	0	184	295 ± 17	< 4	2.0 ± 0.3
-2195	-1475	6-12	0	190	125 ± 5	< 4	2.3 ± 0.3
-2160	-2600	0-34	33	608	17 ± 1	? 7 ± 2	2.4 ± 0.2
-2160	-2600	0- 6	0	526	63 ± 3	? 8 ± 2	2.7 ± 0.3
-2160	-2600	6-12	0	531	23 ± 1	? 6 ± 2	2.6 ± 0.2
-2135	4400	0- 6	0	772	2 ± 1	? 10 ± 2	1.5 ± 0.4
-2132	3600	0- 6	0	766	1 ± 1	< 2	1.7 ± 0.4
-2112	2400	0- 6	0	877	3 ± 1	< 2	1.8 ± 0.4
-2104	-1600	0-39	23	656	45 ± 2	? 8 ± 2	? 1.5 ± 0.2
-2104	-1600	0- 6	0	182	54 ± 2	< 3	2.4 ± 0.2
-2104	-1600	6-12	0	186	67 ± 2	< 3	2.1 ± 0.2
-2102	4000	0- 6	0	769	19 ± 1	< 3	1.3 ± 0.3
-2102	4000	6-12	0	770	28 ± 2	< 3	1.4 ± 0.4

Table B-1 (continued)

Grid <u>Coordinates</u>		Depth (in.)	Bore- hole No.	MMU No.	Concentration		
North	East				Ra-226 (pCi/g)	Thorium (ppm)	Potassium (%)
-2100	4380	0- 6	0	798	139 ± 5	? 4 ± 1	? 0.8 ± 0.1
-2100	4380	6-12	0	799	109 ± 5	? 6 ± 2	? 1.2 ± 0.2
-2092	-1200	0- 6	0	317	17 ± 1	< 3	1.7 ± 0.4
-2092	-1200	6-12	0	334	9 ± 1	< 2	2.0 ± 0.5
-2060	-2404	0- 6	0	113	136 ± 7	< 4	1.8 ± 0.5
-2060	-2404	6-12	0	114	21 ± 1	< 2	2.0 ± 0.5
-2060	-2404	12-18	0	115	16 ± 1	! 8 ± 3	1.8 ± 0.4
-2040	-2000	0-84	26	601	565 ± 21	< 6	2.1 ± 0.3
-2040	-2000	0- 6	0	153	240 ± 10	< 6	< 0.8
-2040	-2000	6-12	0	155	272 ± 12	< 7	< 0.8
-2034	4000	0- 6	0	795	5 ± 1	! 7 ± 3	2.1 ± 0.5
-2034	4000	6-12	0	797	8 ± 1	< 2	1.9 ± 0.4
-2000	200	0- 6	0	565	1 ± 1	! 8 ± 2	1.8 ± 0.4
-2000	-200	0- 6	0	154	3 ± 1	< 2	1.6 ± 0.4
-2000	-200	0- 6	0	376	3 ± 1	? 10 ± 2	2.5 ± 0.2
-2000	-400	0- 6	0	369	2 ± 1	! 13 ± 3	1.3 ± 0.3
-2000	-600	0- 6	0	362	14 ± 1	< 3	1.6 ± 0.4
-2000	-800	0- 6	0	353	5 ± 1	< 2	1.6 ± 0.4
-2000	1400	0- 6	0	775	1 ± 1	< 2	1.5 ± 0.4
-2000	-1000	0- 6	0	343	7 ± 1	! 11 ± 3	1.8 ± 0.4
-2000	-1145	0- 6	0	320	203 ± 11	< 6	1.4 ± 0.4
-2000	-1145	6-12	0	326	21 ± 1	! 8 ± 4	2.0 ± 0.5
-2000	-1200	0- 6	0	318	4 ± 1	< 2	1.6 ± 0.4
-2000	-1265	0- 6	0	319	38 ± 2	< 3	1.5 ± 0.4
-2000	-1400	0- 6	0	198	11 ± 1	? 8 ± 2	2.4 ± 0.2
-2000	-1600	0- 6	0	181	3 ± 1	? 7 ± 1	2.6 ± 0.2
-2000	-1800	0- 6	0	168	1 ± 1	? 9 ± 2	? 2.0 ± 0.2
-2000	-1969	0- 6	0	156	171 ± 8	< 6	1.6 ± 0.4
-2000	-1969	6-12	0	157	53 ± 3	< 4	1.8 ± 0.5
-2000	-1969	0-39	25	658	41 ± 2	? 5 ± 1	? 1.9 ± 0.3
-2000	-1969	0-39	27	602	86 ± 4	? 9 ± 3	2.1 ± 0.2
-2000	-2000	0-33	28	603	2 ± 1	? 10 ± 2	2.5 ± 0.2
-2000	-2075	0- 6	0	160	42 ± 2	< 3	< 0.6
-2000	-2075	6-12	0	166	17 ± 1	? 7 ± 2	2.6 ± 0.2
-2000	-2200	0- 6	0	136	33 ± 2	< 3	1.7 ± 0.4
-2000	-2400	0- 6	0	112	6 ± 1	? 7 ± 2	1.8 ± 0.4
-2000	-2585	0- 6	0	515	6 ± 1	< 2	1.8 ± 0.4
-1973	3600	0- 6	0	827	3 ± 1	? 8 ± 2	2.3 ± 0.2
-1973	3600	6-12	0	828	2 ± 1	? 9 ± 2	2.3 ± 0.2
-1944	-1000	0- 6	0	321	251 ± 15	< 6	? 0.6 ± 0.2
-1944	-1000	6-12	0	351	36 ± 2	< 3	1.6 ± 0.4
-1940	2000	0- 6	0	764	5 ± 1	< 3	? 1.4 ± 0.4
-1934	4000	0- 6	0	829	2 ± 1	! 12 ± 2	2.6 ± 0.2
-1933	3200	0- 6	0	767	2 ± 1	< 2	? 1.0 ± 0.3
-1912	-2400	0- 6	0	765	5 ± 1	< 3	? 0.8 ± 0.3
-1892	-2000	0- 6	0	158	66 ± 4	< 4	1.4 ± 0.4
-1892	-2000	6-12	0	161	76 ± 5	< 4	? 1.3 ± 0.3

Table B-1 (continued)

Grid <u>Coordinates</u>		Bore- hole No.	MMJ No.	Concentration			
North	East	Depth (in.)		Ra-226 (pCi/g)	Thorium (ppm)	Potassium (%)	
-1885	1600	0- 6	0	876	2 ± 1	< 2	2.0 ± 0.5
-1873	2400	0- 6	0	816	69 ± 3	< 4	1.2 ± 0.4
-1873	2400	6-12	0	817	17 ± 1	7 ± 3	1.6 ± 0.4
-1856	-2200	0- 6	0	134	352 ± 19	< 7	< 0.8
-1856	-2200	6-12	0	135	56 ± 3	< 4	1.3 ± 0.4
-1844	3200	0- 6	0	818	10 ± 1	! 7 ± 3	1.4 ± 0.4
-1835	2800	0- 6	0	768	3 ± 1	? 4 ± 2	1.6 ± 0.4
-1822	2000	0- 6	0	781	19 ± 1	< 3	1.8 ± 0.5
-1822	2000	6-12	0	782	13 ± 1	< 2	2.0 ± 0.5
-1821	-2410	0- 6	0	109	199 ± 9	< 5	1.8 ± 0.5
-1821	-2410	6-12	0	110	250 ± 11	< 6	1.8 ± 0.5
-1821	-2410	12-18	0	111	49 ± 2	< 3	2.3 ± 0.5
-1800	0	0- 6	0	382	4 ± 1	? 10 ± 2	2.4 ± 0.2
-1800	200	0- 6	0	566	2 ± 1	! 6 ± 2	2.1 ± 0.5
-1800	-200	0- 6	0	375	2 ± 1	? 10 ± 2	2.5 ± 0.2
-1800	-400	0- 6	0	370	3 ± 1	! 8 ± 2	2.0 ± 0.5
-1800	-600	0- 6	0	363	6 ± 1	< 2	1.8 ± 0.4
-1800	-800	0- 6	0	352	1 ± 1	< 2	1.7 ± 0.4
-1800	-1000	0- 6	0	333	2 ± 1	! 11 ± 3	2.1 ± 0.5
-1800	-1200	0- 6	0	322	2 ± 1	< 2	1.5 ± 0.4
-1800	-1400	0-36	24	657	34 ± 2	? 8 ± 2	? 1.8 ± 0.2
-1800	-1400	0- 6	0	197	111 ± 5	< 3	2.7 ± 0.3
-1800	-1400	6-12	0	325	107 ± 5	< 5	2.0 ± 0.5
-1800	-1600	0- 6	0	180	20 ± 1	< 3	1.5 ± 0.4
-1800	-1800	0- 6	0	167	6 ± 1	? 10 ± 2	2.3 ± 0.2
-1800	-2000	0- 6	0	159	5 ± 1	< 2	1.3 ± 0.3
-1800	-2200	0- 6	0	133	5 ± 1	< 2	1.3 ± 0.3
-1800	-2350	0- 6	0	399	343 ± 17	< 6	< 0.3
-1800	-2350	6-12	0	510	239 ± 15	< 5	< 0.7
-1800	-2400	0- 6	0	108	4 ± 1	! 8 ± 3	2.0 ± 0.5
-1800	-2500	0- 6	0	392	35 ± 2	< 3	1.9 ± 0.5
-1800	-2500	6-12	0	509	65 ± 4	< 3	1.9 ± 0.5
-1800	-2600	0- 6	0	514	3 ± 1	< 2	? 1.0 ± 0.3
-1773	3600	0- 6	0	796	4 ± 1	! 8 ± 3	1.7 ± 0.4
-1740	-2200	0- 6	0	132	183 ± 12	< 5	< 0.7
-1738	1800	0- 6	0	763	2 ± 1	< 2	1.4 ± 0.4
-1725	2800	0- 6	0	783	4 ± 1	! 9 ± 3	1.8 ± 0.4
-1722	2000	0- 6	0	785	3 ± 1	! 8 ± 3	2.1 ± 0.5
-1706	1800	0- 6	0	780	6 ± 1	! 6 ± 3	1.8 ± 0.4
-1644	3200	0- 6	0	784	2 ± 1	! 8 ± 3	1.8 ± 0.4
-1600	0	0- 6	0	381	7 ± 1	? 8 ± 2	2.5 ± 0.2
-1600	200	0- 6	0	558	16 ± 1	? 3 ± 1	? 1.0 ± 0.2
-1600	400	0- 6	0	628	2 ± 1	? 10 ± 3	? 1.2 ± 0.3
-1600	400	0- 6	0	557	2 ± 1	? 9 ± 2	? 1.2 ± 0.2
-1600	600	0- 6	0	617	6 ± 1	? 5 ± 2	? 1.0 ± 0.3
-1600	600	6-12	0	618	5 ± 1	< 2	? 0.9 ± 0.2
-1600	749	0-60	63	752	37 ± 2	? 2 ± 1	? 1.1 ± 0.2

Table B-1 (continued)

Grid Coordinates		Depth (in.)	Bore- hole No.	MMI No.	Concentration		
North	East				Ra-226 (pCi/g)	Thorium (ppm)	Potassium (%)
-1600	749	0- 6	0	629	148 ± 7	< 5	? 0.6 ± 0.2
-1600	749	6-12	0	619	138 ± 7	< 5	< 0.7
-1600	800	0- 6	0	620	7 ± 1	< 3	1.4 ± 0.4
-1600	-200	0- 6	0	374	4 ± 1	? 7 ± 1	2.5 ± 0.2
-1600	-400	0- 6	0	371	7 ± 1	< 2	1.7 ± 0.4
-1600	-600	0- 6	0	364	3 ± 1	< 2	1.6 ± 0.4
-1600	-800	0- 6	0	350	7 ± 1	? 7 ± 1	2.6 ± 0.2
-1600	1000	0- 6	0	710	5 ± 1	< 2	? 1.2 ± 0.3
-1600	1200	0- 6	0	807	4 ± 1	? 7 ± 2	1.7 ± 0.4
-1600	2400	0- 6	0	826	6 ± 1	? 8 ± 2	2.5 ± 0.2
-1600	-1000	0- 6	0	332	7 ± 1	? 9 ± 3	2.2 ± 0.5
-1600	-1200	0- 6	0	323	16 ± 1	< 3	? 1.1 ± 0.3
-1600	-1400	0- 6	0	196	19 ± 1	? 7 ± 2	3.5 ± 0.3
-1600	-1600	0- 6	0	179	3 ± 1	< 2	2.0 ± 0.5
-1600	-1800	0- 6	0	164	11 ± 1	? 2 ± 1	? 1.4 ± 0.2
-1600	-2000	0- 6	0	825	3 ± 1	? 9 ± 2	2.5 ± 0.2
-1600	-2000	0- 6	0	162	3 ± 1	? 8 ± 2	1.5 ± 0.4
-1600	-2200	0- 6	0	130	4 ± 1	? 7 ± 2	1.5 ± 0.4
-1600	-2200	6-12	0	131	2 ± 1	? 8 ± 2	? 1.2 ± 0.3
-1600	-2330	0- 6	0	398	151 ± 7	< 5	1.6 ± 0.5
-1600	-2330	6-12	0	511	240 ± 12	< 5	< 0.7
-1600	-2400	0- 6	0	105	12 ± 1	? 2 ± 3	1.5 ± 0.4
-1600	-2400	6-12	0	106	18 ± 1	< 2	1.5 ± 0.4
-1600	-2400	12-18	0	107	27 ± 2	< 3	1.5 ± 0.4
-1600	-2600	0- 6	0	513	14 ± 1	< 3	1.6 ± 0.4
-1600	-2800	0- 6	0	529	1 ± 1	? 8 ± 1	2.2 ± 0.2
-1585	1600	0- 6	0	761	27 ± 1	< 2	1.6 ± 0.4
-1585	1600	6-12	0	762	32 ± 2	< 2	1.5 ± 0.4
-1550	-1200	6-12	0	348	22 ± 1	? 7 ± 2	2.5 ± 0.2
-1550	-2200	0-52	31	606	26 ± 1	? 6 ± 2	2.4 ± 0.2
-1550	-2200	0- 6	0	128	114 ± 7	< 4	? 1.0 ± 0.3
-1550	-2200	6-12	0	129	97 ± 6	< 4	? 0.8 ± 0.3
-1536	1600	0-56	71	774	36 ± 2	< 3	? 0.9 ± 0.3
-1536	1600	0- 6	0	814	264 ± 12	< 6	1.2 ± 0.5
-1536	1600	6-12	0	815	289 ± 13	< 6	< 0.4
-1530	-1200	0- 6	0	324	72 ± 3	< 4	? 1.2 ± 0.3
-1529	-2400	0-53	32	607	6 ± 1	? 9 ± 2	2.2 ± 0.2
-1529	-2400	0- 6	0	102	8 ± 1	? 6 ± 3	1.6 ± 0.4
-1529	-2400	6-12	0	103	22 ± 1	< 2	1.9 ± 0.4
-1529	-2400	12-18	0	104	5 ± 1	? 9 ± 3	1.7 ± 0.4
-1402	-2593	0- 6	0	512	28 ± 2	< 3	? 0.8 ± 0.2
-1400	0	0- 6	0	553	2 ± 1	? 7 ± 2	? 1.3 ± 0.2
-1400	200	0- 6	0	611	2 ± 1	? 8 ± 1	1.8 ± 0.2
-1400	200	0- 6	0	554	4 ± 1	? 11 ± 2	? 1.5 ± 0.2
-1400	400	0- 6	0	627	3 ± 1	< 2	1.6 ± 0.4
-1400	600	0- 6	0	630	10 ± 1	< 3	1.6 ± 0.4
-1400	600	6-12	0	621	5 ± 1	? 7 ± 2	1.5 ± 0.4

Table B-1 (continued)

Grid		Bore-		MMJ No.	Concentration					
<u>Coordinates</u>	<u>North</u>	<u>Depth</u>	<u>hole</u>		No.	Ra-226 (pCi/g)	Thorium (ppm)	Potassium (%)		
East	(in.)									
-1400	800	0- 6	0	709	5 + 1	< 2		1.5 + 0.4		
-1400	-200	0- 6	0	373	5 + 1	? 10 + 2		2.0 + 0.2		
-1400	-400	0- 6	0	372	5 + 1	! 6 + 3		1.9 + 0.4		
-1400	-600	0- 6	0	365	5 + 1	< 2		2.2 + 0.5		
-1400	-800	0- 6	0	349	6 + 1	? 8 + 2		2.6 + 0.2		
-1400	1000	0- 6	0	711	7 + 1	? 10 + 3		1.6 + 0.4		
-1400	1000	6-12	0	686	6 + 1	8 + 3		2.0 + 0.4		
-1400	1200	0- 6	0	806	2 + 1	< 2		1.9 + 0.5		
-1400	1400	0- 6	0	759	163 + 8	< 5		1.0 + 0.4		
-1400	1400	6-12	0	760	110 + 5	< 4		1.3 + 0.4		
-1400	1600	0- 6	0	821	11 + 1	< 2		1.8 + 0.4		
-1400	1600	6-12	0	822	9 + 1	< 2		1.8 + 0.4		
-1400	2000	0- 6	0	824	5 + 1	! 9 + 3		1.9 + 0.4		
-1400	-1000	0- 6	0	331	15 + 1	< 2		2.0 + 0.5		
-1400	-1200	0- 6	0	328	11 + 1	! 9 + 3		1.9 + 0.4		
-1400	-2000	0- 6	0	163	45 + 2	< 4		2.1 + 0.5		
-1400	-2000	6-12	0	165	14 + 1	? 10 + 2		2.9 + 0.3		
-1400	-2200	0- 6	0	127	12 + 1	< 3		1.7 + 0.4		
-1400	-2305	0- 6	0	396	29 + 2	< 3		1.8 + 0.4		
-1400	-2305	6-12	0	508	24 + 1	< 3		1.6 + 0.4		
-1400	-2400	0- 6	0	101	3 + 1	! 11 + 3		1.2 + 0.3		
-1400	-2450	0- 6	0	397	26 + 1	< 2		1.9 + 0.5		
-1397	-2793	0- 6	0	530	4 + 1	? 6 + 1		2.8 + 0.3		
-1392	-3188	0- 6	0	847	2 + 1	! 9 + 2		1.8 + 0.4		
-1326	1400	0- 6	0	778	143 + 6	< 5		< 0.8		
-1326	1400	6-12	0	779	486 + 21	< 8		< 0.9		
-1325	-2200	0- 6	0	404	24 + 1	< 3		2.0 + 0.5		
-1325	-2200	6-12	0	413	13 + 1	? 8 + 2		2.5 + 0.2		
-1320	1575	0-53	70	773	231 + 14	< 6		< 0.7		
-1320	1575	0- 6	0	793	256 + 12	< 6		< 0.3		
-1320	1575	6-12	0	794	283 + 14	< 6		1.1 + 0.4		
-1300	0	0- 6	0	340	2 + 1	! 5 + 2		1.9 + 0.4		
-1300	-200	0- 6	0	339	6 + 1	! 8 + 3		1.8 + 0.4		
-1300	-200	6-12	0	555	7 + 1	? 8 + 2		? 1.8 + 0.3		
-1300	-400	0- 6	0	338	2 + 1	! 11 + 3		1.8 + 0.4		
-1300	-600	0- 6	0	337	7 + 1	! 9 + 3		1.8 + 0.4		
-1300	-800	0- 6	0	336	12 + 1	< 2		2.0 + 0.5		
-1300	-800	6-12	0	341	17 + 1	< 2		1.7 + 0.4		
-1300	-1000	0- 6	0	330	3 + 1	! 10 + 3		2.1 + 0.5		
-1300	-1000	6-12	0	342	3 + 1	! 10 + 3		1.9 + 0.4		
-1300	-1200	0- 6	0	329	10 + 1	! 8 + 3		1.7 + 0.4		
-1300	-2459	0-32	0	679	326 + 19	< 5		1.9 + 0.3		
-1300	-2459	0- 6	0	417	353 + 20	< 5		? 1.5 + 0.3		
-1300	-2459	6-12	0	423	324 + 18	< 5		2.2 + 0.6		
-1295	1200	0-60	62	751	34 + 2	? 5 + 1		? 1.5 + 0.2		
-1295	1200	0- 6	0	804	137 + 6	< 5		? 1.0 + 0.3		
-1295	1200	6-12	0	805	36 + 2	< 3		? 1.2 + 0.3		

Table B-1 (continued)

Grid <u>Coordinates</u>		Bore- hole No.	MMJ No.	Concentration			
North	East	Depth (in.)		Ra-226 (pCi/g)	Thorium (ppm)	Potassium (%)	
-1275	1025	0-63	61	700	49 ± 3	< 4	1.4 ± 0.4
-1275	1025	0- 6	0	802	221 ± 11	< 6	< 0.7
-1275	1025	6-12	0	803	226 ± 13	< 6	< 0.7
-1275	-2000	0- 6	0	522	57 ± 4	< 3	2.6 ± 0.3
-1275	-2000	6-12	0	406	29 ± 2	< 2	2.0 ± 0.5
-1269	-3313	0- 6	0	430	32 ± 2	< 3	? 1.0 ± 0.3
-1269	-3313	6-12	0	440	6 ± 1	< 2	< 0.6
-1267	1200	0- 6	0	809	125 ± 6	< 5	< 0.8
-1267	1200	6-12	0	810	104 ± 5	< 5	< 0.7
-1249	-2559	0-57	34	677	46 ± 2	? 7 ± 2	2.8 ± 0.3
-1249	-2559	0-12	0	424	32 ± 2	< 2	2.2 ± 0.5
-1249	-2559	0- 6	0	418	233 ± 12	< 4	2.2 ± 0.3
-1238	-2599	0-24	35	678	35 ± 2	? 8 ± 2	2.6 ± 0.3
-1238	-2599	0- 6	0	419	69 ± 3	< 3	2.3 ± 0.3
-1238	-2599	6-12	0	425	36 ± 2	< 3	1.7 ± 0.4
-1219	-3391	0- 6	0	431	1 ± 1	? 6 ± 2	1.9 ± 0.4
-1218	-2994	0- 6	0	422	90 ± 5	< 3	1.7 ± 0.4
-1218	-2994	6-12	0	436	12 ± 1	< 3	2.0 ± 0.5
-1217	-3322	0- 6	0	429	86 ± 5	< 4	? 0.5 ± 0.2
-1217	-3322	6-12	0	439	19 ± 1	< 3	? 0.6 ± 0.2
-1213	-3176	0-72	39	719	156 ± 8	10 ± 2	1.1 ± 0.4
-1213	-3176	0- 6	0	427	382 ± 27	< 6	< 0.7
-1213	-3176	6-12	0	437	287 ± 14	< 7	< 0.8
-1213	-3194	0-71	38	718	49 ± 2	< 3	1.5 ± 0.4
-1213	-3194	0- 6	0	428	42 ± 2	< 3	? 1.0 ± 0.3
-1213	-3194	6-12	0	438	39 ± 2	< 4	< 0.7
-1208	-2994	0- 6	0	421	29 ± 2	< 2	1.6 ± 0.4
-1208	-2994	6-12	0	435	31 ± 2	< 3	? 0.9 ± 0.3
-1200	0	0- 6	0	669	3 ± 1	? 9 ± 2	2.4 ± 0.2
-1200	200	0- 6	0	610	3 ± 1	? 10 ± 2	2.1 ± 0.2
-1200	400	0- 6	0	626	1 ± 1	< 2	1.8 ± 0.4
-1200	600	0- 6	0	631	14 ± 1	< 3	? 1.2 ± 0.3
-1200	600	6-12	0	622	7 ± 1	< 3	1.5 ± 0.4
-1200	800	0- 6	0	704	64 ± 3	< 4	? 1.0 ± 0.3
-1200	800	6-12	0	684	6 ± 1	! 8 ± 3	1.6 ± 0.4
-1200	820	0-41	59	698	16 ± 1	< 3	1.5 ± 0.4
-1200	820	0- 6	0	705	137 ± 6	< 5	? 0.6 ± 0.2
-1200	820	6-12	0	685	30 ± 2	< 2	1.9 ± 0.4
-1200	898	0-25	60	699	133 ± 9	< 5	? 0.7 ± 0.2
-1200	898	0- 6	0	708	171 ± 8	< 5	< 0.7
-1200	898	6-12	0	801	201 ± 10	< 6	< 0.7
-1200	1000	0- 6	0	701	22 ± 1	< 3	1.7 ± 0.4
-1200	1200	0- 6	0	808	97 ± 4	< 5	< 0.7
-1200	1200	0-91	69	758	17 ± 1	< 3	1.3 ± 0.3
-1200	1200	6-12	0	811	150 ± 7	< 5	< 0.7
-1200	1400	0- 6	0	819	28 ± 2	7 ± 3	1.9 ± 0.5
-1200	1400	6-12	0	820	5 ± 1	! 8 ± 3	1.9 ± 0.5

Table B-1 (continued)

Grid <u>Coordinates</u>		Bore- hole No.	MMJ No.	Concentration			
North	East	Depth (in.)		Ra-226 (pCi/g)	Thorium (ppm)	Potassium (%)	
-1200	1600	0- 6	0	787	2 + 1	! 10 + 2	2.1 + 0.5
-1200	1800	0- 6	0	786	19 + 1	! 10 + 4	2.0 + 0.5
-1200	2000	0- 6	0	788	7 + 1	! 5 + 3	1.8 + 0.4
-1200	-2000	0- 6	0	523	4 + 1	? 7 + 1	2.3 + 0.2
-1200	-2200	0- 6	0	403	2 + 1	! 8 + 3	2.0 + 0.5
-1200	-2400	0- 6	0	408	10 + 1	! 7 + 3	1.9 + 0.5
-1198	-2581	0- 6	0	409	9 + 1	? 10 + 2	? 1.6 + 0.2
-1198	-2601	0- 6	0	410	21 + 1	? 5 + 1	? 1.6 + 0.2
-1197	-2679	0- 6	0	426	55 + 3	< 3	1.8 + 0.4
-1197	-2679	6-12	0	434	30 + 1	? 7 + 2	2.4 + 0.2
-1197	-2799	0- 6	0	420	20 + 1	? 8 + 2	2.9 + 0.3
-1190	730	0-36	58	697	26 + 2	< 3	1.5 + 0.4
-1190	730	0- 6	0	703	58 + 3	< 4	? 1.0 + 0.3
-1190	730	6-12	0	683	105 + 5	5 + 3	1.9 + 0.5
-1134	1245	0- 6	0	812	241 + 11	< 6	< 0.8
-1134	1245	6-12	0	813	258 + 12	< 6	< 0.3
-1120	790	0- 6	0	702	123 + 5	< 4	? 0.2 + 0.1
-1120	790	0-64	68	757	41 + 2	< 3	? 1.2 + 0.3
-1120	790	6-12	0	682	78 + 4	< 3	1.5 + 0.4
-1120	-3366	0- 6	0	432	52 + 5	< 3	1.2 + 0.3
-1120	-3366	6-12	0	441	156 + 8	< 5	< 0.7
-1109	-3331	0-18	40	720	131 + 9	< 3	1.8 + 0.2
-1075	52	0- 6	0	712	326 + 17	< 6	< 0.7
-1028	-3597	0- 6	0	597	2 + 1	! 7 + 2	1.8 + 0.4
-1028	-3597	6-12	0	473	2 + 1	? 7 + 2	? 2.0 + 0.3
-1027	49	0- 6	0	713	320 + 14	< 6	< 0.8
-1026	-3538	0- 6	0	598	29 + 2	? 8 + 2	? 1.7 + 0.2
-1026	-3538	6-12	0	472	37 + 2	? 9 + 2	? 1.5 + 0.2
-1022	-3400	0- 6	0	599	13 + 1	? 5 + 1	2.0 + 0.2
-1022	-3400	0-60	41	721	21 + 1	? 8 + 2	2.2 + 0.2
-1022	-3400	6-12	0	467	31 + 2	< 3	? 1.0 + 0.3
-1021	-3385	0- 6	0	600	90 + 6	< 3	1.8 + 0.2
-1021	-3385	6-12	0	466	63 + 5	? 2 + 1	? 1.9 + 0.3
-1018	-3300	0- 6	0	455	55 + 4	? 7 + 2	? 1.9 + 0.3
-1018	-3300	6-12	0	442	154 + 8	< 5	? 1.1 + 0.3
-1016	680	0-66	0	633	25 + 2	< 3	< 0.7
-1016	680	0-69	67	756	46 + 2	< 3	? 1.2 + 0.3
-1016	680	6-12	0	624	61 + 3	< 4	1.4 + 0.4
-1015	-3199	0- 6	0	462	? 1 + 1	? 7 + 2	? 1.5 + 0.2
-1009	-2992	0-60	42	722	26 + 1	? 9 + 2	2.3 + 0.2
-1009	-2992	0- 6	0	464	153 + 10	< 9	? 1.4 + 0.2
-1009	-2992	6-12	0	444	128 + 6	? 9 + 2	? 1.6 + 0.2
-1009	-3000	0- 6	0	463	15 + 1	? 7 + 2	? 2.0 + 0.3
-1009	-3000	6-12	0	443	17 + 1	? 6 + 1	? 1.9 + 0.2
-1001	-2801	6-12	0	469	25 + 2	< 3	1.6 + 0.4
-1000	0	0- 6	0	667	18 + 1	? 6 + 1	2.3 + 0.3
-1000	0	6-12	0	668	30 + 1	? 7 + 2	2.3 + 0.2

Table B-1 (continued)

Grid <u>Coordinates</u>		Bore- hole No.	MMJ No.	Concentration			
North	East	Depth (in.)		Ra-226 (pCi/g)	Thorium (ppm)	Potassium (%)	
-1000	50	0- 6	0	714	249 ± 14	< 5	< 0.7
-1000	200	0- 6	0	675	8 ± 1	? 9 ± 2	2.6 ± 0.2
-1000	200	0-30	65	754	77 ± 3	? 4 ± 1	? 1.2 ± 0.2
-1000	200	6-12	0	609	14 ± 1	? 8 ± 2	2.3 ± 0.2
-1000	400	0- 6	0	616	7 ± 1	? 10 ± 2	2.2 ± 0.2
-1000	600	0-70	66	755	2 ± 1	? 6 ± 2	1.2 ± 0.3
-1000	600	0- 6	0	632	7 ± 1	? 4 ± 2	? 0.9 ± 0.3
-1000	600	6-12	0	623	21 ± 1	< 3	? 1.0 ± 0.3
-1000	800	0- 6	0	647	11 ± 1	? 10 ± 3	1.9 ± 0.5
-1000	800	6-12	0	680	27 ± 1	? 8 ± 2	2.3 ± 0.2
-1000	1000	0- 6	0	644	28 ± 2	< 3	1.5 ± 0.4
-1000	1200	0- 6	0	776	66 ± 4	< 4	< 0.8
-1000	1200	6-12	0	777	20 ± 1	< 3	? 1.2 ± 0.3
-1000	1400	0- 6	0	792	2 ± 1	? 9 ± 3	2.0 ± 0.5
-1000	1600	0- 6	0	791	3 ± 1	? 10 ± 3	1.9 ± 0.4
-1000	1800	0- 6	0	790	3 ± 1	? 7 ± 3	2.1 ± 0.5
-1000	2000	0- 6	0	789	3 ± 1	? 9 ± 3	1.8 ± 0.4
-1000	-1800	0- 6	0	517	4 ± 1	? 7 ± 2	1.6 ± 0.4
-1000	-2000	0- 6	0	519	20 ± 1	< 3	1.8 ± 0.4
-1000	-2000	6-12	0	524	17 ± 1	? 9 ± 2	2.5 ± 0.2
-1000	-2200	0- 6	0	520	15 ± 1	< 3	1.5 ± 0.4
-1000	-2200	6-12	0	402	15 ± 1	? 8 ± 3	2.1 ± 0.5
-1000	-2300	0- 6	0	405	99 ± 5	< 4	1.5 ± 0.4
-1000	-2300	6-12	0	414	37 ± 1	? 8 ± 2	2.7 ± 0.3
-1000	-2400	0- 6	0	407	75 ± 4	< 4	1.7 ± 0.5
-1000	-2400	6-12	0	415	68 ± 3	< 3	2.3 ± 0.2
-1000	-2800	0- 6	0	468	51 ± 4	< 3	1.7 ± 0.4
-998	962	0- 6	0	645	188 ± 9	< 5	1.0 ± 0.4
-998	-2601	0- 6	0	411	3 ± 1	? 4 ± 1	? 1.9 ± 0.2
-998	-2601	6-12	0	416	2 ± 1	? 10 ± 2	2.8 ± 0.3
-960	875	0- 6	0	646	203 ± 9	< 5	1.9 ± 0.6
-960	875	6-12	0	681	191 ± 7	< 4	2.2 ± 0.3
-925	-1800	0- 6	0	516	111 ± 7	< 4	1.5 ± 0.4
-925	-1800	6-12	0	518	146 ± 9	< 5	1.7 ± 0.5
-925	-2000	0- 6	0	521	354 ± 21	< 5	? 1.3 ± 0.2
-925	-2000	6-12	0	525	218 ± 11	< 4	2.0 ± 0.3
-925	-2015	0-20	36	717	60 ± 3	4 ± 2	2.2 ± 0.5
-925	-2800	0-59	49	499	32 ± 2	< 3	1.6 ± 0.4
-850	-2200	0- 6	0	401	678 ± 37	< 9	< 0.4
-850	-2200	6-12	0	412	365 ± 17	? 1 ± 1	? 1.2 ± 0.2
-846	-3481	0- 6	0	585	26 ± 2	< 3	? 1.1 ± 0.3
-846	-3481	6-12	0	688	26 ± 2	< 3	1.2 ± 0.3
-841	-3811	0- 6	0	593	1 ± 1	< 2	1.8 ± 0.4
-836	-3708	0- 6	0	588	53 ± 4	< 3	? 0.8 ± 0.2
-836	-3708	6-12	0	690	24 ± 2	< 3	1.3 ± 0.3
-831	-3605	0- 6	0	587	9 ± 1	< 2	? 0.9 ± 0.2
-831	-3605	6-12	0	689	13 ± 1	< 3	1.8 ± 0.4

Table B-1 (continued)

Grid <u>Coordinates</u>		Bore- hole No.	MMJ No.	Concentration			
North	East	Depth (in.)		Ra-226 (pCi/g)	Thorium (ppm)	Potassium (%)	
-830	-3580	0- 6	0	586	115 ± 7	< 5	? 0.8 ± 0.3
-824	-3408	0- 6	0	452	25 ± 1	< 9	? 1.8 ± 0.2
-815	-3205	0- 6	0	451	10 ± 1	? 12 ± 3	? 1.8 ± 0.2
-815	-3205	6-12	0	465	12 ± 1	? 5 ± 1	? 1.6 ± 0.2
-810	-3065	0-58	44	728	18 ± 1	? 10 ± 3	? 1.5 ± 0.2
-810	-3065	0- 6	0	461	28 ± 2	? 7 ± 2	? 1.7 ± 0.2
-810	-3065	6-12	0	450	68 ± 3	< 4	< 0.7
-808	-3005	0- 6	0	460	4 ± 1	? 7 ± 2	? 1.7 ± 0.3
-808	-3005	6-12	0	449	6 ± 1	< 2	1.7 ± 0.4
-802	-2806	0-60	47	731	18 ± 1	? 10 ± 2	2.8 ± 0.3
-802	-2806	0- 6	0	459	37 ± 2	? 9 ± 2	? 1.9 ± 0.3
-802	-2806	6-12	0	445	35 ± 2	< 8	? 1.5 ± 0.2
-800	0	0- 6	0	665	26 ± 1	< 2	1.8 ± 0.4
-800	0	6-12	0	666	24 ± 1	< 2	1.8 ± 0.4
-800	62	0- 6	0	715	29 ± 2	< 2	1.5 ± 0.4
-800	200	0- 6	0	673	26 ± 1	? 9 ± 2	2.5 ± 0.2
-800	200	0-34	64	753	7 ± 1	? 7 ± 2	? 1.5 ± 0.2
-800	200	6-12	0	674	56 ± 2	< 3	2.0 ± 0.2
-800	400	0- 6	0	615	6 ± 1	? 10 ± 2	2.3 ± 0.2
-800	600	0- 6	0	634	8 ± 1	< 3	? 1.0 ± 0.3
-800	800	0- 6	0	648	5 ± 1	! 8 ± 3	1.6 ± 0.4
-800	1000	0- 6	0	643	3 ± 1	! 9 ± 3	1.6 ± 0.4
-800	-3575	6-12	0	687	16 ± 1	< 3	1.2 ± 0.3
-798	-2602	0- 6	0	470	46 ± 2	? 9 ± 2	? 1.6 ± 0.2
-798	-2602	0-44	48	498	45 ± 2	< 3	1.5 ± 0.4
-798	-2602	6-12	0	471	55 ± 3	? 4 ± 1	? 1.2 ± 0.2
-734	-3611	0- 6	0	495	286 ± 15	< 6	1.2 ± 0.4
-734	-3611	6-12	0	497	97 ± 5	< 4	1.4 ± 0.4
-657	-4017	0- 6	0	594	145 ± 7	< 4	1.5 ± 0.5
-657	-4017	6-12	0	496	540 ± 27	< 8	< 0.4
-656	-3816	0- 6	0	591	330 ± 22	< 7	< 0.7
-656	-3816	6-12	0	491	179 ± 10	< 5	1.8 ± 0.5
-652	-3818	0-27	50	500	160 ± 8	< 5	1.3 ± 0.4
-647	-3837	0- 6	0	592	206 ± 14	< 6	< 0.7
-646	-3817	0- 6	0	590	9 ± 1	< 2	1.2 ± 0.3
-636	-3617	0- 6	0	584	12 ± 1	< 3	? 1.4 ± 0.4
-632	-3517	0- 6	0	549	66 ± 5	< 4	? 1.1 ± 0.3
-632	-3517	6-12	0	492	55 ± 3	< 3	1.4 ± 0.4
-628	44	0- 6	0	716	94 ± 5	< 4	1.4 ± 0.4
-628	-3418	0- 6	0	546	129 ± 11	< 5	? 0.8 ± 0.3
-627	-3418	0-28	53	691	422 ± 42	< 7	< 0.7
-627	-3418	0- 6	0	548	31 ± 2	< 3	1.3 ± 0.3
-627	-3418	6-12	0	493	31 ± 2	< 2	1.7 ± 0.4
-624	-3340	0- 6	0	453	56 ± 3	? 4 ± 1	? 1.4 ± 0.2
-623	-3418	0- 6	0	547	1730 ± 180	< 13	< 0.9
-618	-3210	0- 6	0	454	11 ± 1	? 7 ± 2	? 1.4 ± 0.2
-604	-2800	0-48	45	729	50 ± 2	? 6 ± 2	? 2.0 ± 0.2

Table B-1 (continued)

Grid Coordinates		Depth (in.)	Bore- hole No.	MMJ No.	Concentration			
North	East				Ra-226 (pCi/g)	Thorium (ppm)	Potassium (%)	
-604	-2800	0- 6	0	456	96 + 5	? 7 + 2	? 1.0 + 0.2	
-604	-2800	6-12	0	448	76 + 5	< 5	< 0.9	
-600	0	0- 6	0	663	23 + 1	! 8 + 3	1.8 + 0.4	
-600	0	6-12	0	664	22 + 1	< 2	1.8 + 0.4	
-600	200	0- 6	0	672	12 + 1	? 6 + 2	2.6 + 0.3	
-600	400	0- 6	0	614	6 + 1	? 7 + 2	2.3 + 0.2	
-600	600	0- 6	0	635	5 + 1	! 9 + 3	1.5 + 0.4	
-600	800	0- 6	0	642	3 + 1	! 10 + 3	1.7 + 0.4	
-600	1000	0- 6	0	641	4 + 1	! 8 + 3	1.6 + 0.4	
-600	-2660	0-59	46	730	121 + 4	< 4	? 1.9 + 0.2	
-600	-2660	0- 6	0	457	118 + 5	? 3 + 1	? 1.2 + 0.2	
-600	-2660	6-12	0	447	44 + 2	? 9 + 2	? 1.3 + 0.2	
-598	-2600	0- 6	0	458	14 + 1	? 7 + 2	? 1.5 + 0.2	
-598	-2600	6-12	0	446	6 + 1	? 4 + 1	? 1.9 + 0.3	
-597	-3419	0- 6	0	545	344 + 28	< 7	< 0.7	
-597	-3419	6-12	0	494	361 + 22	< 6	< 0.3	
-456	-4014	6-12	0	490	5 + 1	! 6 + 2	1.6 + 0.4	
-456	-4019	0-28	51	649	5 + 1	? 11 + 3	1.4 + 0.4	
-455	-3993	0-22	52	650	3 + 1	< 2	1.6 + 0.4	
-455	-3993	0- 6	0	595	24 + 1	< 2	2.0 + 0.5	
-455	-3993	6-12	0	484	102 + 5	< 4	1.7 + 0.5	
-447	-3823	0- 6	0	589	1 + 1	? 6 + 2	2.0 + 0.5	
-447	-3823	6- 9	0	483	3 + 1	! 7 + 2	1.7 + 0.4	
-433	-3608	0- 6	0	582	362 + 28	< 10	? 1.5 + 0.3	
-433	-3608	6-12	0	481	185 + 10	< 5	1.7 + 0.5	
-433	-3622	0- 6	0	583	58 + 4	< 4	1.3 + 0.4	
-433	-3622	6-12	0	482	72 + 4	< 3	1.9 + 0.5	
-416	-4021	0- 6	0	596	16 + 1	< 2	1.6 + 0.4	
-416	-4021	6-12	0	489	124 + 7	< 4	1.5 + 0.5	
-400	0	0- 6	0	661	31 + 2	< 2	1.9 + 0.4	
-400	0	6-12	0	662	67 + 3	< 3	1.4 + 0.4	
-400	200	0- 6	0	671	23 + 1	? 7 + 2	? 1.6 + 0.2	
-400	400	0- 6	0	613	10 + 1	? 9 + 2	? 1.9 + 0.2	
-400	600	0- 6	0	636	7 + 1	! 10 + 3	1.5 + 0.4	
-400	800	0- 6	0	639	6 + 1	! 7 + 3	1.6 + 0.4	
-400	1000	0- 6	0	640	4 + 1	! 9 + 3	1.5 + 0.4	
-320	-3830	0- 6	0	581	31 + 2	< 2	1.7 + 0.4	
-320	-3830	6- 9	0	573	31 + 3	< 3	2.1 + 0.5	
-300*	3935*	0- 6	0	293	81 + 3	? 11 + 3	? 1.1 + 0.2	
-300*	3935*	6-12	0	294	19 + 1	? 8 + 2	? 1.2 + 0.2	
-246	-3863	0-29	56	694	9 + 1	< 2	1.4 + 0.4	
-246	-3863	0- 6	0	579	96 + 5	< 4	1.8 + 0.5	
-246	-3863	6-12	0	572	90 + 5	< 4	1.6 + 0.4	
-245	-3834	0- 6	0	580	8 + 1	! 9 + 3	2.1 + 0.5	
-245	-3834	6- 9	0	574	5 + 1	< 2	1.8 + 0.4	
-241	-3735	0- 6	0	577	64 + 3	< 3	1.5 + 0.4	
-241	-3735	6-12	0	575	114 + 7	< 5	? 1.3 + 0.4	

Table B-1 (continued)

Grid		Bore-		MMJ No.	Concentration					
<u>Coordinates</u>		Depth (in.)	hole No.		Ra-226 (pCi/g)			Thorium (ppm)		Potassium (%)
North	East				!<	<	!<	!<	!<	?
-237	-3637	0- 6	0	576	5 + 1	< 2		1.8 + 0.4		
-234	-3236	0- 6	0	539	14 + 1	< 2		1.3 + 0.3		
-231	-3497	0-54	55	693	44 + 3	< 3		? 1.1 + 0.3		
-231	-3497	0- 6	0	550	45 + 4	< 3		1.3 + 0.4		
-231	-3497	6-12	0	476	40 + 3	< 3		1.7 + 0.4		
-229	-3437	0- 6	0	544	26 + 2	< 3		1.5 + 0.4		
-229	-3437	6-12	0	477	16 + 1	< 2		1.8 + 0.4		
-219	-3237	0- 6	0	540	11 + 1	! 10 + 3		1.2 + 0.3		
-219	-3237	6-12	0	479	56 + 3	< 3		1.4 + 0.4		
-219	-3247	0-22	54	692	56 + 4	< 4		? 0.8 + 0.3		
-219	-3247	0- 6	0	541	72 + 4	< 3		1.7 + 0.4		
-209	-3038	0- 6	0	538	7 + 1	! 5 + 2		1.6 + 0.4		
-200	0	0- 6	0	659	7 + 1	! 9 + 2		1.4 + 0.3		
-200	0	6-12	0	660	8 + 1	9 + 2		1.6 + 0.4		
-200	200	0- 6	0	670	20 + 1	? 6 + 2		? 1.7 + 0.2		
-200	400	0- 6	0	612	5 + 1	? 7 + 1		1.7 + 0.2		
-200	600	0- 6	0	637	15 + 1	< 2		1.6 + 0.4		
-200	800	0- 6	0	638	4 + 1	! 8 + 3		1.2 + 0.3		
-200	-3210	6-12	0	480	213 + 10	< 5		1.4 + 0.5		
-179	-3239	0- 6	0	542	229 + 13	< 6		< 0.7		
-179	-3239	6-12	0	478	260 + 12	< 6		1.1 + 0.4		
-140	1800	0- 6	0	823	4 + 1	! 9 + 2		2.0 + 0.5		
-119	-3241	0- 6	0	543	8 + 1	< 2		1.5 + 0.4		
-119	-3241	6-12	0	485	42 + 2	< 3		1.4 + 0.4		
-85	-3045	0- 6	0	537	38 + 2	< 3		1.3 + 0.4		
-47	-3857	0-30	57	695	39 + 2	< 3		1.7 + 0.4		
-47	-3857	0- 6	0	578	137 + 7	5 + 3		1.8 + 0.5		
-47	-3857	6-12	0	569	201 + 10	< 5		2.0 + 0.5		
-47	-3857	12-18	0	488	418 + 20	< 7		< 0.4		
-46	-3842	0- 6	0	570	2 + 1	! 7 + 2		2.0 + 0.5		
-37	-3644	0- 6	0	571	1 + 1	! 11 + 3		2.1 + 0.5		
-28	-3445	0- 6	0	475	27 + 2	< 2		2.2 + 0.5		
-28	-3445	6-12	0	486	4 + 1	! 10 + 3		2.0 + 0.5		
-28	-3445	12-18	0	487	4 + 1	! 13 + 3		1.9 + 0.5		
-20	600	0- 6	0	249	2 + 1	! 18 + 3		? 0.7 + 0.2		
-20	-3244	0- 6	0	474	4 + 1	! 9 + 2		1.5 + 0.4		
-10	-200	0- 6	0	242	2 + 1	< 2		1.5 + 0.3		
-10	-3050	0- 6	0	536	3 + 1	! 11 + 3		1.6 + 0.4		
0	0	0-14	101	625	1 + 1	< 2		1.5 + 0.4		
0	0	0- 6	0	95	?	1 + 1	?	1.6 + 0.2		
0	0	0-30	100	676	1 + 1	?	9 + 1	2.6 + 0.2		
0	0	0- 6	0	96	?	1 + 1	4 + 1	? 1.8 + 0.3		
0	0	0- 6	0	727	?	1 + 1	5 + 1	? 2.1 + 0.3		
0	0	0- 6	0	567	1 + 1	!	9 + 2	1.8 + 0.4		
0	0	0-21	43	725	2 + 1	?	9 + 2	2.4 + 0.2		
0	0	0- 6	0	568	1 + 1	!	6 + 2	1.9 + 0.4		
0	0	0- 6	0	724	1 + 1	?	9 + 2	2.4 + 0.2		

Table B-1 (continued)

Grid <u>Coordinates</u>		Bore- hole No.	MMI No.	Concentration			
North	East	Depth (in.)		Ra-226 (pCi/g)	Thorium (ppm)	Potassium (%)	
0	0	0- 6	0	259	1 + 1	< 2	1.6 + 0.4
0	0	0- 6	0	723	2 + 1	? 7 + 1	2.2 + 0.2
0	0	0- 6	0	260	1 + 1	< 2	? 1.1 + 0.3
0	-600	0- 6	0	209	11 + 1	? 7 + 2	? 1.2 + 0.1
0	-600	6-12	0	210	17 + 1	? 6 + 2	? 1.4 + 0.2
0	-800	0- 6	0	204	3 + 1	? 10 + 2	2.0 + 0.2
0	1000	0- 6	0	71	11 + 1	< 3	? 0.6 + 0.2
0	1017	0- 6	0	276	4 + 1	? 9 + 2	? 1.7 + 0.2
0	1190	0- 6	0	292	7 + 1	? 3 + 1	? 0.9 + 0.1
0	-1200	0- 6	0	70	25 + 2	< 3	< 0.6
0	-1600	6-12	0	66	11 + 1	< 3	? 0.8 + 0.2
0	-1800	0- 6	0	41	120 + 5	? 10 + 3	? 1.6 + 0.3
0	-1800	6-12	0	64	39 + 2	< 4	? 0.6 + 0.2
0	-2000	0- 6	0	32	5 + 1	? 9 + 2	? 2.0 + 0.3
0	-2200	0- 6	0	16	21 + 1	< 2	1.7 + 0.4
0	-2200	6-12	0	17	7 + 1	? 9 + 3	1.6 + 0.4
0	-2400	0- 6	0	1	10 + 1	? 8 + 3	1.7 + 0.4
0	-2400	6-12	0	2	11 + 1	? 8 + 3	1.6 + 0.4
0	-2400	12-18	0	3	10 + 1	? 7 + 3	1.3 + 0.3
0	-2600	0- 6	0	222	20 + 1	? 4 + 1	? 1.9 + 0.3
0	-2600	6-12	0	223	21 + 1	? 12 + 3	? 1.7 + 0.2
0	-2800	0- 6	0	261	4 + 1	< 2	1.6 + 0.4
0*	3925*	0- 6	0	271	47 + 2	< 3	1.8 + 0.5
0*	3925*	6-12	0	272	20 + 1	10 + 3	1.6 + 0.4
1	1 ^a	0- 0	0	696	7185 + 299	< 28	< 1.7
5	800	0- 6	0	250	1 + 1	< 7 + 2	1.9 + 0.4
10	-1600	0- 6	0	46	75 + 4	< 4	1.6 + 0.4
12	400	0- 6	0	98	? 2 + 1	? 7 + 2	? 1.4 + 0.2
12	-1800	0- 6	0	40	154 + 6	? 2 + 1	? 1.0 + 0.2
12	-1800	6-12	0	63	21 + 1	< 3	< 0.7
15	200	0- 6	0	232	2 + 1	? 8 + 2	? 1.1 + 0.2
15	-1400	0- 6	0	47	20 + 1	< 2	0.7 + 0.2
19	-600	0- 6	0	213	4 + 1	? 6 + 1	? 1.3 + 0.2
20	0	0- 6	0	233	2 + 1	? 5 + 1	? 0.8 + 0.1
23	-2200	0- 6	0	18	107 + 5	< 4	1.6 + 0.5
23	-2200	6-12	0	19	24 + 1	< 2	1.8 + 0.5
24	-398	0- 6	0	726	118 + 5	< 4	1.9 + 0.2
39	-600	0- 6	0	214	25 + 1	? 9 + 2	? 1.5 + 0.2
39	-600	6-12	0	215	26 + 1	? 8 + 2	? 1.3 + 0.2
62	0	0- 6	0	234	33 + 2	? 7 + 2	? 1.7 + 0.3
71	-2000	0- 6	0	33	102 + 5	< 9	? 1.7 + 0.3
71	-2000	6-12	0	54	36 + 2	< 3	< 0.7
100	-2750	0- 6	0	262	124 + 6	< 5	< 0.7
100	-2750	6-12	0	263	236 + 13	< 6	< 0.7
130	-1800	0- 6	0	39	225 + 11	< 12	? 1.5 + 0.3

^aSample collected on foundation of Building 5, Room A (see Appendix I for location information).

Table B-1 (continued)

Grid Coordinates		Bore- hole No.	MMI No.	Concentration		
North	East	Depth (in.)		Ra-226 (pCi/g)	Thorium (ppm)	Potassium (%)
130	-1800	6-12	0	62	494 ± 22	< 0.9
200	0	0- 6	0	235	17 ± 1	? 1.5 ± 0.2
200	0	6-12	0	236	2 ± 1	? 1.9 ± 0.3
200	200	0- 6	0	230	5 ± 1	? 1.3 ± 0.2
200	200	6-12	0	231	4 ± 1	? 1.2 ± 0.2
200	400	0- 6	0	97	9 ± 1	? 1.4 ± 0.2
200	600	0- 6	0	277	1 ± 1	? 1.8 ± 0.2
200	800	0- 6	0	282	3 ± 1	? 1.5 ± 0.4
200	-200	0- 6	0	243	22 ± 1	? 1.0 ± 0.2
200	-400	0- 6	0	216	33 ± 2	? 1.6 ± 0.2
200	-400	6-12	0	217	4 ± 1	? 1.9 ± 0.2
200	-600	0- 6	0	211	2 ± 1	? 2.5 ± 0.2
200	-800	0- 6	0	205	17 ± 1	? 1.5 ± 0.2
200	-800	6-12	0	206	10 ± 1	? 1.6 ± 0.2
200	1220	0- 6	0	290	20 ± 1	? 1.3 ± 0.2
200	1220	6-12	0	291	22 ± 1	? 1.1 ± 0.2
200	-1000	0- 6	0	72	2 ± 1	? 0.7 ± 0.2
200	-1200	0- 6	0	69	8 ± 1	< 0.6
200	-1220	0-24	11	295	15 ± 1	? 1.3 ± 0.2
200	-1400	0- 6	0	48	4 ± 1	0.6 ± 0.2
200	-1600	0- 6	0	45	34 ± 2	1.0 ± 0.3
200	-1600	6-12	0	65	9 ± 1	< 0.7
200	-1800	0- 6	0	38	87 ± 4	? 1.5 ± 0.2
200	-1800	6-12	0	61	120 ± 4	? 1.9 ± 0.2
200	-2000	6-12	0	52	5 ± 1	1.6 ± 0.4
200	-2000	12-18	0	53	3 ± 1	? 1.0 ± 0.3
200	-2200	0- 6	0	20	8 ± 1	1.6 ± 0.4
200	-2200	6-12	0	21	3 ± 1	1.6 ± 0.4
200	-2400	0- 6	0	4	19 ± 1	1.6 ± 0.4
200	-2400	6-12	0	5	7 ± 1	2.0 ± 0.5
200	-2600	0- 6	0	224	22 ± 1	? 1.5 ± 0.2
200	-2600	6-12	0	225	5 ± 1	? 1.5 ± 0.2
200	-2800	0- 6	0	264	2 ± 1	< 0.7
210	-2000	0- 6	0	31	97 ± 5	? 1.2 ± 0.2
229	-1000	0-51	13	296	11 ± 1	? 1.4 ± 0.2
229	-1000	0- 6	0	73	23 ± 1	< 0.7
229	-1000	6-12	0	74	32 ± 2	? 1.0 ± 0.3
340	-2610	0- 6	0	251	131 ± 7	? 1.5 ± 0.4
340	-2610	6-12	0	252	146 ± 7	1.5 ± 0.4
390	-1400	0- 6	0	49	3 ± 1	1.7 ± 0.4
396	600	0- 6	0	278	18 ± 1	? 1.8 ± 0.2
400	0	0- 6	0	237	4 ± 1	? 1.8 ± 0.3
400	200	0- 6	0	229	2 ± 1	? 1.5 ± 0.2
400	400	0- 6	0	99	5 ± 1	? 1.4 ± 0.2
400	600	0- 6	0	279	10 ± 1	2.1 ± 0.2
400	800	0- 6	0	283	9 ± 1	1.4 ± 0.4

Table B-1 (continued)

Grid Coordinates		Depth (in.)	Bore- hole No.	MMJ No.	Concentration			
North	East				Ra-226 (pCi/g)	Thorium (ppm)	Potassium (%)	
400	-200	0- 6	0	244	9 ± 1	? 7 ± 2	1.5 ± 0.4	
400	-400	0- 6	0	220	6 ± 1	? 13 ± 3	? 1.4 ± 0.2	
400	-400	6-12	0	221	? 2 ± 1	? 6 ± 2	? 1.5 ± 0.2	
400	-600	0- 6	0	212	11 ± 1	? 5 ± 1	? 1.8 ± 0.2	
400	-800	0- 6	0	207	3 ± 1	? 9 ± 2	2.3 ± 0.2	
400	1200	0- 6	0	286	12 ± 1	< 2	1.5 ± 0.4	
400	1200	6-12	0	287	10 ± 1	? 7 ± 3	1.4 ± 0.4	
400	-1000	0- 6	0	75	2 ± 1	< 2	? 1.0 ± 0.3	
400	-1200	0- 6	0	68	3 ± 1	< 2	? 0.7 ± 0.2	
400	-1600	0- 6	0	44	10 ± 1	? 8 ± 3	1.6 ± 0.4	
400	-1800	0- 6	0	37	31 ± 2	? 4 ± 1	? 1.0 ± 0.2	
400	-1800	6-12	0	60	4 ± 1	? 8 ± 3	1.2 ± 0.3	
400	-2000	0- 6	0	30	19 ± 1	? 8 ± 2	? 1.5 ± 0.2	
400	-2200	0- 6	0	22	39 ± 2	? 9 ± 2	? 1.6 ± 0.2	
400	-2200	6-12	0	23	56 ± 2	? 6 ± 2	? 1.7 ± 0.3	
400	-2400	0- 6	0	6	5 ± 1	? 5 ± 2	? 1.8 ± 0.3	
400	-2400	6-12	0	7	19 ± 1	? 8 ± 2	2.8 ± 0.3	
400	-2400	12-18	0	8	28 ± 1	? 8 ± 2	2.8 ± 0.3	
400	-2600	0- 6	0	253	39 ± 2	< 4	1.5 ± 0.4	
400	-2600	6-12	0	254	1 ± 1	< 2	1.8 ± 0.4	
400	-2800	0- 6	0	269	19 ± 1	< 2	1.7 ± 0.4	
400	-2800	6-12	0	270	11 ± 1	? 10 ± 3	1.8 ± 0.4	
405	800	0- 6	0	284	48 ± 3	< 3	1.7 ± 0.5	
405	800	6-12	0	285	56 ± 3	< 3	1.6 ± 0.5	
420	-2400	0- 6	0	9	27 ± 3	? 8 ± 2	? 2.1 ± 0.3	
420	-2400	6-12	0	10	25 ± 3	< 4	? 2.4 ± 0.4	
420	-2400	12-18	0	11	26 ± 3	? 5 ± 2	? 2.2 ± 0.3	
421	-1800	0- 6	0	36	25 ± 2	? 8 ± 2	? 1.0 ± 0.2	
421	-1800	6-12	0	59	93 ± 5	< 4	1.3 ± 0.4	
425	-2000	0- 6	0	29	10 ± 1	? 10 ± 2	? 1.6 ± 0.2	
480	1000	0- 6	0	288	69 ± 4	< 4	1.3 ± 0.4	
480	1000	6-12	0	289	14 ± 1	? 8 ± 3	1.5 ± 0.4	
500	-2400	0- 6	0	12	48 ± 2	? 7 ± 2	2.3 ± 0.2	
500	-2400	6-12	0	13	11 ± 1	? 8 ± 2	2.4 ± 0.2	
600	0	0- 6	0	238	9 ± 1	? 10 ± 2	? 1.6 ± 0.2	
600	0	6-12	0	239	2 ± 1	< 2	1.4 ± 0.3	
600	200	0- 6	0	228	4 ± 1	? 3 ± 1	? 1.5 ± 0.2	
600	400	0- 6	0	100	4 ± 1	< 7	? 0.9 ± 0.2	
600	600	0- 6	0	280	4 ± 1	? 8 ± 3	1.8 ± 0.4	
600	-200	0- 6	0	245	8 ± 1	< 2	? 1.1 ± 0.3	
600	-400	0- 6	0	219	? 1 ± 1	? 7 ± 2	? 1.6 ± 0.2	
600	-800	0- 6	0	208	11 ± 1	? 6 ± 2	2.3 ± 0.2	
600	-1000	0- 6	0	201	13 ± 1	? 8 ± 2	2.6 ± 0.2	
600	-1200	0- 6	0	50	4 ± 1	? 7 ± 3	1.5 ± 0.4	
600	-1400	0- 6	0	76	22 ± 1	< 3	1.5 ± 0.4	
600	-1600	0- 6	0	43	48 ± 2	< 3	1.5 ± 0.4	
600	-1800	0- 6	0	35	8 ± 1	? 1 ± 1	? 1.5 ± 0.2	

Table B-1 (continued)

Grid <u>Coordinates</u>		Bore- hole No.	MMJ No.	Concentration			
North	East	Depth (in.)		Ra-226 (pCi/g)	Thorium (ppm)	Potassium (%)	
600	-1800	6-12	0	58	9 + 1	< 2	1.6 + 0.4
600	-2000	0- 6	0	28	13 + 1	? 8 + 2	? 1.6 + 0.2
600	-2000	6-12	0	51	9 + 1	? 8 + 2	? 1.4 + 0.2
600	-2200	0- 6	0	24	5 + 1	? 8 + 2	? 1.2 + 0.2
600	-2200	6-12	0	25	2 + 1	? 8 + 2	? 1.5 + 0.2
600	-2400	0- 6	0	14	17 + 1	? 8 + 2	2.1 + 0.2
600	-2400	6-12	0	15	23 + 1	< 2	1.8 + 0.4
600	-2600	0- 6	0	255	4 + 1	< 2	2.1 + 0.5
600	-2800	0- 6	0	265	10 + 1	< 3	? 1.1 + 0.3
600	-2800	6-12	0	266	8 + 1	< 3	1.5 + 0.4
632	-2611	0- 6	0	256	78 + 4	< 5	< 0.8
632	-2611	6-12	0	257	103 + 5	< 5	2.2 + 0.5
694	-1800	0- 6	0	34	63 + 4	? 4 + 1	? 1.9 + 0.3
800	0	0- 6	0	240	5 + 1	< 3	1.5 + 0.4
800	200	0- 6	0	227	4 + 1	? 10 + 2	? 2.1 + 0.3
800	400	0- 6	0	226	4 + 1	? 1 + 1	? 1.3 + 0.2
800	600	0- 6	0	281	7 + 1	! 7 + 3	1.6 + 0.4
800	-200	0- 6	0	246	9 + 1	? 8 + 2	1.6 + 0.4
800	-1000	0- 6	0	202	9 + 1	? 9 + 2	2.1 + 0.2
800	-1000	6-12	0	203	2 + 1	? 10 + 2	2.3 + 0.2
800	-1600	0- 6	0	42	1 + 1	! 6 + 2	1.5 + 0.4
800	-1800	0- 6	0	55	21 + 1	< 3	? 0.8 + 0.3
800	-1800	6-12	0	57	2 + 1	< 2	1.4 + 0.4
800	-2000	0- 6	0	27	3 + 1	? 7 + 2	? 1.2 + 0.2
800	-2200	0- 6	0	26	2 + 1	? 1 + 1	? 1.7 + 0.2
800	-2600	0- 6	0	258	2 + 1	? 7 + 2	? 1.1 + 0.3
800	-2800	0- 6	0	267	4 + 1	? 13 + 3	? 1.6 + 0.2
800	-2800	6-12	0	268	4 + 1	? 9 + 2	? 1.4 + 0.2
885*	4300*	0- 6	0	273	34 + 2	< 3	1.7 + 0.4
885*	4300*	6-12	0	274	25 + 1	< 3	1.9 + 0.5
1000	0	0- 6	0	241	3 + 1	? 7 + 2	1.8 + 0.4
1000	200	0- 6	0	94	4 + 1	? 10 + 3	? 1.9 + 0.3
1000	-200	0- 6	0	247	4 + 1	? 10 + 2	1.9 + 0.4
1000	-400	0- 6	0	218	4 + 1	? 5 + 1	? 1.9 + 0.3
1000	-600	0- 6	0	93	2 + 1	! 8 + 3	2.1 + 0.5
1000	-1400	0- 6	0	89	10 + 1	< 2	2.0 + 0.5
1000	-1800	0- 6	0	84	9 + 1	< 3	? 1.1 + 0.3
1000	-2000	0- 6	0	80	9 + 1	< 3	1.5 + 0.4
1000	-2200	0- 6	0	77	9 + 1	? 9 + 3	1.8 + 0.4
1100	-2200	0- 6	0	78	9 + 1	< 3	1.5 + 0.4
1200	-200	0- 6	0	248	2 + 1	< 2	1.7 + 0.4
1200	-1400	0- 6	0	90	7 + 1	< 2	1.9 + 0.4
1200	-1800	0- 6	0	85	6 + 1	< 2	2.0 + 0.5
1200	-1800	6-12	0	86	7 + 1	< 2	1.6 + 0.4
1200	-2000	0- 6	0	81	7 + 1	< 3	1.9 + 0.4
1200	-2200	0- 6	0	79	7 + 1	< 3	1.7 + 0.4
1400	-1400	0- 6	0	91	6 + 1	! 6 + 3	2.0 + 0.5

Table B-1 (continued)

Grid <u>Coordinates</u>		Depth (in.)	Bore- hole No.	MMJ No.	Concentration			Potassium (%)
North	East				Ra-226 (pCi/g)	Thorium (ppm)		
1400	-1400	6-12	0	92	6 ± 1	! 9 ± 3	2.1 ± 0.5	
1400	-1800	0- 6	0	87	7 ± 1	< 3	2.0 ± 0.5	
1400	-2000	0- 6	0	82	6 ± 1	? 8 ± 3	1.5 ± 0.4	
1400	-2200	0- 6	0	83	7 ± 1	? 5 ± 2	1.9 ± 0.5	
1500	-2200	0- 6	0	67	7 ± 1	< 3	1.9 ± 0.5	
1870	-1800	0- 6	0	88	6 ± 1	? 4 ± 2	1.6 ± 0.4	

Table B-2

Radioelement Analyses on Soil Samples

Area ^a	Grid		Depth (in.)	MMJ No.	Radioelement Concentration				
	Coordinates North	Coordinates East			U (ppm)	V (ppm)	Ra-226 (pCi/g)		
NO	23	-2200	0	18	735	160	107		
NO	421	-1800	6	59	49	500	93		
NO	200	-1800	6	61	215	840	120		
NO	130	-1800	6	62	1140	3440	494		
NO	340	-2610	0	251	233	160	131		
NO	632	-2611	6	257	102	650	103		
NO	100	-2750	6	263	624	630	236		
NO	800	-2800	6	268	7	140	4		
SO	-1529	-2400	0	102	12	100	8		
SO	-2518	-2400	6	120	159	140	139		
SO	-1550	-2200	0	128	90	130	114		
SO	-2400	-2200	0	138	91	340	74		
SO	-2450	-2200	0	140	382	280	113		
SO	-2525	-2200	0	142	104	90	81		
SO	-2040	-2000	6	155	407	300	272		
SO	-2195	-1475	0	184	463	200	295		
SO	-2369	-1600	6	194	395	840	196		
SO	-2400	-1700	6	302	213	160	292		
SO	-2200	-1140	6	335	190	300	155		
SO	-2600	-1135	6	357	735	160	339		
EA	-300 ^a	3935 ^a	0	293	38	200	81		

^aAreas are indicated as follows: NO for north area; SO for south area; and EA for east area.

Appendix C

DUPLICATE ANALYTICAL RESULTS

Table C-1 presents duplicate gamma-ray-spectroscopic analytical results for splits of the soil samples reported in Table B-1. The MMJ number is the sample number. An asterisk (*) indicates that approximate coordinates were assigned to the sampling location because it falls outside the surveyed area. Results for six samples show differences slightly greater than expected. Of these, five have a relative difference from the average of less than 10 percent, attributable to sample preparation. Sample MMJ-185 did not duplicate within 10 percent of the average; reanalysis of both the original sample and the split did not significantly change either value.

Table C-1

Duplicate Gamma-Ray-Spectroscopy Analytical Results

Grid Coordinates North	East	MMJ No.	Radium Concentration (pCi/g)		
			Original	Duplicate	Difference
-33924*	20328*	846	1	1	0
-2630	-1970	177	5763	5872	9
-2600	-1280	308	88	94	6
-2600	-600	359	5	5	0
-2525	-2200	142	81	78	3
-2400	-1700	185	181	252	71
-2400	0	383	5	4	1
-2378	5200	831	3	2	1
-2369	-1600	653	11	12	1
-2200	-2452	506	126	120	6
-2160	-2600	531	23	22	1
-2060	-2404	113	136	137	1
-2000	-2000	603	2	2	0
-2000	-1800	168	1	1	0
-2000	-1000	343	7	6	1
-2000	200	565	1	2	1
-2000	1400	775	1	1	0
-1800	-1000	333	2	3	1
-1773	3600	796	4	5	1
-1738	1800	763	2	1	1
-1725	2800	783	4	4	0
-1600	-2400	105	12	13	1
-1600	-2000	825	3	3	0
-1600	-1400	196	19	19	0
-1600	-800	350	7	7	0
-1530	-1200	324	72	62	10
-1400	-2305	396	29	30	1
-1400	-2200	127	12	12	0
-1400	-400	372	5	5	0
-1400	0	553	2	2	0

Table C-1 (continued)

Grid Coordinates		MMJ No.	Radium Concentration (pCi/g)		
North	East		Original	Duplicate	Difference
-1295	1200	751	34	34	0
-1275	-2000	406	29	30	1
-1218	-2994	422	90	102	12
-1217	-3194	439	19	21	2
-1200	898	699	133	117	16
-1200	1200	808	97	84	13
-1120	-3366	432	52	54	2
-1120	790	702	123	108	15
-1016	680	624	61	57	4
-1009	-2992	444	128	127	1
-1000	50	714	249	295	46
-1000	400	616	7	7	0
-998	962	645	188	217	29
-925	-1800	518	146	150	4
-830	-3580	586	115	120	5
-627	-3418	493	31	29	2
-624	-3340	453	56	55	1
-623	-3418	547	1730	1549	181
-455	-3993	650	3	4	1
-447	-3823	483	3	3	0
-416	-4021	596	16	15	1
-400	0	662	67	68	1
-237	-3637	576	5	5	0
-200	-1969	157	53	51	2
0*	3925*	271	47	53	6
5	800	250	1	1	0
10	-1600	46	75	79	4
24	-398	726	118	120	2
200	-2200	21	3	3	0
200	-1800	61	120	119	1
200	-1800	38	87	89	2
229	-1000	296	11	10	1
400	-2000	30	19	19	0
400	0	237	4	4	0
420	-2400	10	25	26	1
600	-2000	52	5	5	0
600	-400	219	1	1	0
800	-1000	203	2	2	0
800	400	226	4	5	1
800	600	281	7	7	0
1000	-1800	84	9	9	0
1100	-2200	78	9	8	1
BACKGROUND SAMPLES					
Background West		95	1	1	0
Background East		259	1	1	0
Background South		676	1	1	0

Appendix D

DISEQUILIBRIUM MEASUREMENT RESULTS

Table D-1 presents the laboratory results for measurements of disequilibrium between radium and its radon daughters in 70 samples; the MCV number is the sample number. The depth indicated is the top of a 6-inch sample interval. The average disequilibrium is 43 ± 12 percent. The East Tailings samples are located near -600N, -400E; analytical results for samples collected on this pile and for samples collected at the approximate location -1200N, -2300E, were taken from Engelder and others (in preparation).

Table D-1

Results of Measurements of Disequilibrium Between Radium and Its Radon Daughters

Area	Depth (in.)	MCV No.	Radium (pCi/g)	Disequilibrium (percent)
East	0	526	17	44
East	6	527	3	48
East	0	528	17	45
East	0	529	13	50
East	0	530	12	34
East	0	531	6	61
North	0	532	6	36
East	0	533	6	41
Creek	0	534	18	48
Creek	0	535	39	48
Creek	0	536	212	23
West	0	537	123	48
West	0	538	157	44
West	0	539	228	28
South	0	540	393	39
South	0	541	10	56
Creek	0	542	147	39
East Tailings Pile	0	601	69	58
East Tailings Pile	0	602	35	1
East Tailings Pile	0	603	55	47
East Tailings Pile	0	604	65	50
East Tailings Pile	0	605	148	35
East Tailings Pile	0	606	71	44
East Tailings Pile	0	607	64	49
East Tailings Pile	0	608	62	51
East Tailings Pile	0	609	68	56
East Tailings Pile	0	610	50	17
East Tailings Pile	0	611	72	49
East Tailings Pile	0	612	90	33
East Tailings Pile	0	613	86	28
East Tailings Pile	0	614	46	35
East Tailings Pile	0	615	59	44

Table D-1 (continued)

Area	Depth (in.)	MCV No.	Radium (pCi/g)	Disequilibrium (percent)
East Tailings Pile	0	616	77	54
East Tailings Pile	0	617	86	52
East Tailings Pile	0	618	193	56
East Tailings Pile	0	619	151	42
East Tailings Pile	0	620	69	52
East Tailings Pile	0	621	60	46
East Tailings Pile	0	622	75	40
East Tailings Pile	0	623	88	27
East Tailings Pile	0	624	152	34
East Tailings Pile	0	625	80	50
East Tailings Pile	0	626	144	53
East Tailings Pile	0	627	115	49
East Tailings Pile	0	628	83	44
East Tailings Pile	0	629	85	39
East Tailings Pile	0	630	86	40
East Tailings Pile	0	631	55	20
East Tailings Pile	0	632	92	39
East Tailings Pile	0	633	50	37
East Tailings Pile	0	634	93	53
East Tailings Pile	0	635	77	55
East Tailings Pile	0	636	112	50
East Tailings Pile	0	688	120	44
East Tailings Pile	0	689	66	40
East Tailings Pile	0	690	85	48

GRID COORDINATES

North East

-300	0	0	551	56	49
-800	-3200	0	552	5	51
-600	-2500	0	553	93	37
-400	-2200	0	554	46	53
-500	-1800	0	555	182	38
-800	-2000	0	556	29	33
-1200	-1600	0	557	2	37
-1300	-1100	0	558	1	32
-700	-1400	0	559	52	44
-800	-1100	0	560	8	46
-1300	-2200	0	561	10	45
-1200	-2300 ^a	0	563	5	35
-1200	-2300	0	564	4	47
-1200	-2300	0	565	3	57
-1200	-2300	0	567	3	73

^aApproximate location.

Appendix E

DELTA-GAMMA RADIUM MEASUREMENT DATA

Table E-1 presents results of the in-situ delta-gamma radium measurements. The two-standard-deviation (2σ) error reported in this table reflects only the uncertainty in the counting statistics; it does not include errors introduced through the use of a calibration factor and three correction factors. These data were generated using the computer program DELTCALC.BAS, Version 1.0. An asterisk (*) indicates that approximate coordinates were assigned to the measurement location because it falls outside the surveyed area.

Table E-1

In-Situ Delta-Gamma Radium Measurement Results

Coordinates		Depth	eRa-226		Coordinates		Depth	eRa-226	
North	East	(in.)	(pCi/g)			North	East	(in.)	(pCi/g)
-33924*	20338*	0	1.6	+ 1.4	-2635	-2440	6	212.1	+ 6.2
-33924*	20328*	0	0.5	+ 1.2	-2635	-2440	0	155.6	+ 6.4
-4870*	13000*	0	35.3	+ 3.3	-2635	-2440	12	36.0	+ 7.1
-4870*	13000*	6	53.5	+ 4.9	-2635	-2440	12	40.6	+ 6.2
-4870*	13000*	12	28.2	+ 5.4	-2635	-2400	0	116.4	+ 6.5
-4670*	13120*	0	1.5	+ 1.6	-2635	-2400	6	16.5	+ 3.5
-3250*	11760*	0	28.2	+ 2.9	-2635	-2400	12	7.9	+ 3.0
-3250*	11760*	6	53.9	+ 3.9	-2632	-2000	0	179.9	+ 8.3
-3250*	11760*	12	70.6	+ 5.1	-2632	-2000	6	179.1	+ 6.7
-3250*	11760*	18	152.1	+ 6.7	-2632	-2000	12	54.6	+ 6.0
-3050*	11670*	0	1.9	+ 1.4	-2631	6000	0	3.7	+ 1.9
-2800	-2000	0	7.3	+ 2.5	-2630	-1970	0	3030.9	+ 19.0
-2800	-2000	6	3.8	+ 1.7	-2630	-1970	6	97.3	+ 5.0
-2800	-1600	0	3.7	+ 2.1	-2630	-1970	12	12.2	+ 5.6
-2800	-1600	6	3.5	+ 1.8	-2630	-1245	0	237.1	+ 7.6
-2800	-1200	0	4.2	+ 2.1	-2630	-1245	6	29.6	+ 4.3
-2800	-1200	6	4.3	+ 2.2	-2630	-1245	12	13.6	+ 3.5
-2800	-400	0	3.0	+ 2.1	-2610	-2359	0	104.0	+ 5.0
-2800	-400	6	7.3	+ 2.2	-2610	-2359	6	4.6	+ 3.0
-2800	200	0	4.8	+ 1.6	-2610	-2359	12	6.0	+ 2.7
-2800	200	6	2.7	+ 1.9	-2610	-2300	0	330.2	+ 10.9
-2800	400	0	5.1	+ 2.3	-2610	-2300	6	206.3	+ 8.7
-2800	400	6	5.7	+ 1.8	-2610	-2300	12	110.5	+ 7.6
-2800	400	12	1.9	+ 1.9	-2600	-2600	0	1.0	+ 2.0
-2800	800	0	4.5	+ 2.3	-2600	-2400	0	4.1	+ 1.9
-2800	800	6	1.3	+ 1.9	-2600	-2400	6	3.8	+ 1.8
-2766	6000	0	5.1	+ 1.9	-2600	-2200	0	4.5	+ 2.0
-2716	6000	0	161.5	+ 6.4	-2600	-2200	6	2.6	+ 1.7
-2716	6000	6	242.8	+ 12.6	-2600	-2100	0	88.2	+ 6.0
-2716	6000	12	256.0	+ 11.2	-2600	-2100	6	12.5	+ 3.9
-2716	6000	18	59.8	+ 9.4	-2600	-2100	12	3.7	+ 2.6
-2681	6000	0	169.1	+ 4.9	-2600	-2000	0	32.0	+ 3.9
-2681	6000	6	162.0	+ 7.3	-2600	-2000	6	17.4	+ 2.6
-2681	6000	12	55.6	+ 5.7	-2600	-2000	12	15.1	+ 2.7

Table E-1 (continued)

<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>		<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>
<u>North</u>	<u>East</u>	(in.)	(pCi/g)		<u>North</u>	<u>East</u>	(in.)	(pCi/g)
-2600	-1800	0	3.4 ± 2.1		-2523	5200	0	4.6 ± 2.0
-2600	-1800	6	2.1 ± 1.7		-2518	-2400	0	161.2 ± 5.9
-2600	-1600	0	9.3 ± 3.0		-2518	-2400	6	311.6 ± 8.0
-2600	-1600	6	4.5 ± 1.7		-2518	-2400	12	250.0 ± 9.8
-2600	-1555	0	933.6 ± 19.3		-2478	5200	0	17.2 ± 2.5
-2600	-1555	6	98.5 ± 11.3		-2478	5200	6	29.0 ± 3.0
-2600	-1555	12	44.2 ± 8.3		-2478	5200	12	4.7 ± 2.5
-2600	-1400	0	23.6 ± 4.0		-2460	-1800	0	64.9 ± 5.9
-2600	-1400	6	2.4 ± 1.9		-2460	-1800	6	4.8 ± 2.6
-2600	-1370	0	1098.8 ± 13.5		-2450	-2200	0	141.9 ± 6.2
-2600	-1370	6	12.2 ± 10.6		-2450	-2200	6	10.6 ± 3.9
-2600	-1280	0	412.2 ± 11.6		-2450	-2200	12	9.7 ± 2.8
-2600	-1280	6	7.9 ± 4.2		-2433	5600	0	3.9 ± 1.5
-2600	-1280	12	9.3 ± 3.6		-2402	5600	0	22.3 ± 2.6
-2600	-1200	0	14.3 ± 3.6		-2402	5600	6	42.8 ± 3.5
-2600	-1200	6	3.8 ± 2.1		-2402	5600	12	75.8 ± 3.9
-2600	-1135	0	228.7 ± 8.3		-2400	-2600	0	3.3 ± 1.8
-2600	-1135	6	347.3 ± 6.5		-2400	-2600	6	2.4 ± 2.3
-2600	-1135	12	120.1 ± 6.4		-2400	-2460	0	988.0 ± 18.1
-2600	-1000	0	6.9 ± 2.5		-2400	-2460	6	103.8 ± 10.0
-2600	-1000	6	3.8 ± 1.7		-2400	-2460	12	49.8 ± 7.3
-2600	-800	0	3.3 ± 1.9		-2400	-2400	0	5.1 ± 1.9
-2600	-800	6	2.1 ± 1.4		-2400	-2400	6	1.9 ± 1.8
-2600	-600	0	5.2 ± 2.3		-2400	-2320	0	2141.7 ± 23.3
-2600	-600	6	2.7 ± 1.4		-2400	-2320	6	362.5 ± 9.9
-2600	-400	0	6.2 ± 2.3		-2400	-2320	12	146.7 ± 11.7
-2600	-400	6	3.4 ± 1.4		-2400	-2200	0	58.8 ± 3.9
-2600	-200	0	4.9 ± 2.3		-2400	-2200	6	36.8 ± 3.9
-2600	-200	6	1.0 ± 1.4		-2400	-2200	12	7.4 ± 3.3
-2600	0	0	7.4 ± 1.9		-2400	-2050	0	27.5 ± 3.6
-2600	0	6	3.4 ± 1.9		-2400	-2050	6	44.5 ± 4.1
-2600	200	0	12.9 ± 2.3		-2400	-2000	0	4.4 ± 2.5
-2600	200	6	11.3 ± 2.5		-2400	-2000	0	3.2 ± 1.7
-2600	200	12	4.8 ± 2.1		-2400	-2000	6	2.7 ± 1.7
-2595	-1700	0	390.7 ± 11.0		-2400	-1954	0	142.5 ± 7.3
-2595	-1700	6	14.2 ± 5.6		-2400	-1954	6	59.7 ± 5.0
-2595	-1700	12	11.0 ± 4.6		-2400	-1954	12	8.3 ± 3.6
-2583	-2000	0	265.5 ± 9.2		-2400	-1800	0	4.3 ± 2.4
-2583	-2000	6	77.7 ± 6.4		-2400	-1800	6	2.1 ± 1.4
-2583	-2000	12	23.8 ± 5.6		-2400	-1700	0	256.8 ± 8.9
-2525	-2200	0	80.4 ± 4.2		-2400	-1700	6	207.3 ± 7.4
-2525	-2200	6	75.8 ± 4.8		-2400	-1700	12	91.3 ± 7.3
-2525	-2200	12	29.5 ± 4.8		-2400	-1614	0	105.0 ± 5.7
-2523	-1600	0	147.9 ± 9.3		-2400	-1614	6	6.9 ± 3.0
-2523	-1600	6	15.4 ± 4.2		-2400	-1614	12	6.4 ± 2.6
-2523	-1600	12	0.8 ± 3.6		-2400	-1600	0	2.8 ± 1.7

Table E-1 (continued)

<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>	<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>
<u>North</u>	<u>East</u>	(in.)	(pCi/g)	<u>North</u>	<u>East</u>	(in.)	(pCi/g)
-2400	-1600	6	0.8 ± 1.3	-2207	-1800	12	3.4 ± 1.9
-2400	-1400	0	2.2 ± 1.8	-2202	4000	0	3.1 ± 1.9
-2400	-1400	6	2.6 ± 1.7	-2200	-2600	0	5.4 ± 2.2
-2400	-1200	0	20.9 ± 3.7	-2200	-2600	6	1.3 ± 2.2
-2400	-1200	6	2.4 ± 1.7	-2200	-2452	0	251.9 ± 10.3
-2400	-1000	0	10.1 ± 2.9	-2200	-2452	6	27.4 ± 7.5
-2400	-1000	6	1.6 ± 1.7	-2200	-2452	12	4.3 ± 4.7
-2400	-800	0	7.6 ± 2.5	-2200	-2400	0	5.3 ± 1.7
-2400	-800	6	2.6 ± 1.8	-2200	-2400	6	0.8 ± 1.6
-2400	-600	0	6.8 ± 2.5	-2200	-2325	0	152.4 ± 7.7
-2400	-600	6	2.0 ± 1.4	-2200	-2325	6	16.3 ± 4.9
-2400	-400	0	5.8 ± 2.3	-2200	-2325	12	6.7 ± 3.4
-2400	-400	6	1.9 ± 1.4	-2200	-2200	0	5.1 ± 2.0
-2400	-200	0	5.1 ± 2.4	-2200	-2200	6	2.0 ± 1.9
-2400	-200	6	2.9 ± 1.4	-2200	-2000	0	5.3 ± 2.6
-2400	0	0	4.0 ± 2.3	-2200	-2000	6	3.5 ± 1.8
-2400	0	6	2.0 ± 1.3	-2200	-1600	0	2.3 ± 1.8
-2400	200	0	6.1 ± 2.3	-2200	-1600	0	4.0 ± 2.3
-2400	200	6	1.9 ± 1.9	-2200	-1600	6	4.4 ± 2.0
-2400	400	0	5.5 ± 2.3	-2200	-1400	0	6.4 ± 2.9
-2400	400	6	1.0 ± 1.8	-2200	-1400	6	0.8 ± 1.4
-2389	4800	0	4.6 ± 1.8	-2200	-1200	0	4.5 ± 2.2
-2379	-1200	0	93.2 ± 6.5	-2200	-1200	6	2.4 ± 1.7
-2379	-1200	6	13.4 ± 3.1	-2200	-1140	0	207.7 ± 8.6
-2379	-1200	12	4.4 ± 2.3	-2200	-1140	6	19.7 ± 5.2
-2378	5200	0	5.6 ± 1.9	-2200	-1140	6	83.0 ± 6.3
-2378	5200	6	3.9 ± 2.0	-2200	-1140	12	12.9 ± 4.4
-2373	5600	0	1.4 ± 1.3	-2200	-1000	0	8.3 ± 2.5
-2369	-1600	0	366.1 ± 10.3	-2200	-1000	6	4.2 ± 1.9
-2369	-1600	6	286.3 ± 9.5	-2200	-800	0	18.2 ± 3.7
-2369	-1600	12	27.8 ± 7.4	-2200	-800	6	4.4 ± 1.9
-2304	4800	0	44.6 ± 3.4	-2200	-600	0	8.0 ± 2.5
-2304	4800	0	48.7 ± 4.0	-2200	-600	6	2.4 ± 1.7
-2304	4800	6	123.6 ± 3.5	-2200	-400	0	4.3 ± 2.0
-2304	4800	12	41.4 ± 5.4	-2200	-400	6	3.1 ± 1.7
-2271	-2400	0	46.5 ± 3.7	-2200	-200	0	4.3 ± 2.3
-2271	-2400	6	3.5 ± 2.6	-2200	-200	6	3.6 ± 1.7
-2270	4800	0	83.4 ± 4.1	-2200	200	0	7.6 ± 2.3
-2270	4800	6	131.5 ± 4.7	-2200	200	6	3.2 ± 1.9
-2270	4800	12	80.9 ± 6.3	-2195	-1475	0	345.1 ± 12.1
-2261	-1400	0	144.1 ± 7.9	-2195	-1475	0	373.6 ± 9.1
-2261	-1400	6	49.9 ± 5.4	-2195	-1475	6	23.8 ± 5.7
-2261	-1400	12	9.5 ± 3.4	-2195	-1475	12	9.8 ± 4.0
-2244	4800	0	5.6 ± 2.0	-2160	-2600	0	42.3 ± 4.1
-2207	-1800	0	42.3 ± 4.4	-2160	-2600	6	12.0 ± 3.9
-2207	-1800	6	5.4 ± 2.5	-2160	-2600	12	8.5 ± 3.6

Table E-1 (continued)

<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>		<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>	
North	East	(in.)	(pCi/g)		North	East	(in.)	(pCi/g)	
-2144	4800	0	2.6	+ 1.8	-2000	-1400	0	12.3	+ 2.9
-2135	4400	0	3.4	+ 1.9	-2000	-1400	6	3.5	+ 1.9
-2132	3600	0	2.6	+ 2.0	-2000	-1265	0	46.5	+ 5.6
-2132	3600	6	3.8	+ 2.1	-2000	-1265	6	3.8	+ 2.1
-2112	2400	0	4.0	+ 2.0	-2000	-1200	0	4.4	+ 2.6
-2104	-1600	0	67.3	+ 5.0	-2000	-1200	6	2.9	+ 1.8
-2104	-1600	6	77.8	+ 4.8	-2000	-1145	0	364.3	+ 10.4
-2104	-1600	12	76.3	+ 5.3	-2000	-1145	6	10.3	+ 3.9
-2102	4000	0	14.8	+ 2.9	-2000	-1145	12	6.9	+ 3.4
-2102	4000	6	18.8	+ 3.1	-2000	-1000	0	7.6	+ 2.8
-2102	4000	12	4.1	+ 2.5	-2000	-1000	6	4.6	+ 1.8
-2100	4380	0	94.3	+ 4.6	-2000	-800	0	7.5	+ 2.7
-2100	4380	6	71.8	+ 5.1	-2000	-800	6	3.4	+ 1.8
-2100	4380	12	33.1	+ 3.7	-2000	-600	0	8.7	+ 2.8
-2092	-1200	0	32.2	+ 5.3	-2000	-600	6	4.5	+ 1.9
-2092	-1200	6	5.5	+ 2.8	-2000	-400	0	2.6	+ 1.7
-2092	-1200	12	2.9	+ 2.1	-2000	-400	6	2.0	+ 1.5
-2060	-2404	0	125.1	+ 4.7	-2000	-200	0	3.7	+ 1.8
-2060	-2404	6	10.6	+ 4.0	-2000	-200	6	2.5	+ 1.6
-2060	-2404	12	7.4	+ 3.3	-2000	200	0	3.3	+ 2.1
-2040	-2000	0	678.2	+ 15.1	-2000	200	6	2.9	+ 1.7
-2040	-2000	6	862.6	+ 5.8	-2000	1400	0	2.0	+ 1.6
-2040	-2000	12	1793.4	+ 10.4	-1973	3600	0	4.8	+ 1.5
-2034	4000	0	7.3	+ 1.9	-1973	3600	6	6.0	+ 2.0
-2034	4000	6	9.4	+ 2.1	-1973	3600	12	4.5	+ 2.1
-2034	4000	12	6.3	+ 2.3	-1950	4380	0	2.9	+ 1.9
-2000	-2800	0	2.9	+ 1.7	-1944	-1000	0	286.3	+ 9.5
-2000	-2585	0	5.6	+ 2.3	-1944	-1000	6	10.6	+ 5.6
-2000	-2585	6	3.6	+ 1.8	-1944	-1000	6	14.3	+ 4.5
-2000	-2400	0	3.4	+ 1.7	-1944	-1000	12	6.0	+ 3.4
-2000	-2400	6	2.4	+ 1.7	-1940	2000	0	4.8	+ 2.2
-2000	-2200	0	18.5	+ 2.6	-1940	2000	6	4.1	+ 2.2
-2000	-2200	6	4.8	+ 2.4	-1934	4000	0	5.2	+ 1.9
-2000	-2075	0	43.0	+ 4.8	-1933	3200	0	2.8	+ 1.9
-2000	-2075	6	14.7	+ 2.8	-1933	3200	6	2.7	+ 2.0
-2000	-2075	12	9.8	+ 2.6	-1912	2400	0	10.9	+ 2.3
-2000	-2000	0	6.0	+ 2.1	-1912	2400	6	4.4	+ 2.3
-2000	-2000	0	4.0	+ 1.8	-1892	-2000	0	127.7	+ 6.9
-2000	-1969	0	173.8	+ 9.0	-1892	-2000	6	81.3	+ 5.2
-2000	-1969	6	13.4	+ 4.3	-1892	-2000	12	75.6	+ 5.3
-2000	-1969	12	14.3	+ 3.7	-1885	1600	0	3.0	+ 1.9
-2000	-1800	0	4.8	+ 2.2	-1873	2400	0	56.4	+ 3.5
-2000	-1800	0	1.5	+ 1.5	-1873	2400	6	15.3	+ 4.4
-2000	-1800	6	2.5	+ 1.4	-1873	2400	12	11.2	+ 3.7
-2000	-1600	0	6.2	+ 2.2	-1856	-2200	0	264.9	+ 7.5
-2000	-1600	6	1.7	+ 1.4	-1856	-2200	6	25.8	+ 6.8

Table E-1 (continued)

<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>	<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>
<u>North</u>	<u>East</u>	(in.)	(pCi/g)	<u>North</u>	<u>East</u>	(in.)	(pCi/g)
-1856	-2200	12	3.5 ± 4.9	-1800	0	0	2.6 ± 1.9
-1844	3200	0	9.3 ± 2.1	-1800	0	6	1.4 ± 1.3
-1844	3200	6	5.5 ± 2.3	-1800	200	0	2.2 ± 1.8
-1835	2800	0	3.0 ± 2.0	-1798	-2999	0	3.0 ± 1.6
-1835	2800	6	2.9 ± 2.1	-1773	3600	0	3.6 ± 1.4
-1822	2000	0	16.2 ± 1.9	-1744	3200	0	9.0 ± 1.9
-1822	2000	6	9.9 ± 2.3	-1740	-2200	0	214.7 ± 7.1
-1822	2000	12	5.5 ± 2.4	-1740	-2200	6	3.6 ± 5.2
-1821	-2410	0	213.7 ± 7.0	-1738	1800	0	3.5 ± 1.9
-1821	-2410	6	57.2 ± 6.6	-1738	1800	6	4.3 ± 2.0
-1821	-2410	12	12.1 ± 5.9	-1725	2800	0	4.7 ± 1.4
-1800	-2800	0	4.1 ± 2.3	-1725	2800	6	5.0 ± 1.5
-1800	-2600	0	3.1 ± 1.8	-1722	2000	0	5.4 ± 1.7
-1800	-2600	6	4.0 ± 1.8	-1706	1800	0	4.8 ± 1.8
-1800	-2500	0	40.0 ± 4.6	-1706	1800	6	4.0 ± 1.9
-1800	-2500	6	60.5 ± 4.6	-1644	3200	0	3.5 ± 1.7
-1800	-2500	12	24.8 ± 4.4	-1605	1000	0	3.4 ± 1.8
-1800	-2400	0	2.5 ± 1.9	-1600	-3000	0	3.2 ± 2.1
-1800	-2400	6	3.4 ± 1.8	-1600	-2800	0	3.2 ± 2.0
-1800	-2350	0	394.3 ± 11.7	-1600	-2800	6	1.2 ± 2.0
-1800	-2350	6	45.2 ± 7.0	-1600	-2600	0	8.3 ± 2.8
-1800	-2350	12	15.6 ± 5.7	-1600	-2600	6	2.1 ± 2.4
-1800	-2200	0	4.9 ± 2.3	-1600	-2400	0	10.7 ± 2.1
-1800	-2200	6	3.1 ± 2.0	-1600	-2400	6	17.1 ± 2.4
-1800	-2000	0	7.1 ± 2.7	-1600	-2400	12	15.0 ± 2.7
-1800	-2000	6	4.1 ± 1.8	-1600	-2330	0	117.6 ± 7.3
-1800	-1800	0	6.8 ± 2.6	-1600	-2330	6	14.9 ± 4.9
-1800	-1800	6	2.2 ± 1.5	-1600	-2330	12	9.4 ± 3.8
-1800	-1600	0	15.6 ± 3.4	-1600	-2200	0	7.7 ± 2.1
-1800	-1600	6	14.0 ± 2.6	-1600	-2200	6	5.1 ± 1.9
-1800	-1400	0	176.4 ± 7.9	-1600	-2200	12	3.2 ± 1.9
-1800	-1400	6	83.1 ± 6.2	-1600	-2000	0	8.3 ± 3.0
-1800	-1400	12	77.0 ± 7.6	-1600	-2000	6	4.1 ± 1.9
-1800	-1200	0	4.1 ± 1.8	-1600	-1800	0	13.8 ± 3.1
-1800	-1200	0	3.2 ± 1.8	-1600	-1800	6	0.8 ± 1.5
-1800	-1200	6	4.7 ± 1.8	-1600	-1600	0	4.4 ± 1.9
-1800	-1000	0	4.3 ± 2.3	-1600	-1600	6	2.2 ± 1.5
-1800	-1000	6	2.6 ± 1.4	-1600	-1400	0	16.9 ± 3.6
-1800	-800	0	1.6 ± 1.6	-1600	-1400	6	3.0 ± 1.7
-1800	-800	6	0.4 ± 1.3	-1600	-1200	0	7.8 ± 2.2
-1800	-600	0	7.1 ± 2.4	-1600	-1200	6	2.1 ± 1.5
-1800	-600	6	3.1 ± 1.8	-1600	-1000	0	12.9 ± 3.0
-1800	-400	0	2.7 ± 1.8	-1600	-1000	6	2.0 ± 1.6
-1800	-400	6	2.7 ± 1.4	-1600	-800	0	12.5 ± 2.7
-1800	-200	0	3.3 ± 1.7	-1600	-800	6	3.0 ± 1.9
-1800	-200	6	3.7 ± 1.6	-1600	-600	0	2.3 ± 1.7

Table E-1 (continued)

<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>		<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>	
<u>North</u>	<u>East</u>	(in.)	(pCi/g)		<u>North</u>	<u>East</u>	(in.)	(pCi/g)	
-1600	-600	6	2.1	+ 1.4	-1400	-2800	6	3.9	+ 2.2
-1600	-400	0	4.3	+ 2.3	-1400	-2600	0	6.3	+ 2.0
-1600	-400	6	3.1	+ 1.4	-1400	-2600	6	2.7	+ 1.9
-1600	-200	0	5.9	+ 2.4	-1400	-2450	0	66.1	+ 5.8
-1600	-200	6	3.3	+ 1.7	-1400	-2450	6	3.4	+ 2.7
-1600	0	0	4.8	+ 2.3	-1400	-2400	0	2.4	+ 1.7
-1600	0	6	1.8	+ 1.4	-1400	-2400	6	2.3	+ 1.7
-1600	200	0	8.0	+ 2.4	-1400	-2305	0	18.2	+ 3.7
-1600	200	6	3.0	+ 1.8	-1400	-2305	6	6.5	+ 2.7
-1600	400	0	2.6	+ 1.7	-1400	-2305	12	9.4	+ 2.6
-1600	400	6	1.5	+ 1.7	-1400	-2200	0	12.5	+ 1.8
-1600	600	0	6.3	+ 2.1	-1400	-2200	6	4.1	+ 2.0
-1600	600	6	6.3	+ 2.1	-1400	-2000	0	30.9	+ 4.3
-1600	600	12	2.3	+ 1.8	-1400	-2000	6	7.2	+ 2.7
-1600	749	0	154.8	+ 7.2	-1400	-2000	12	5.5	+ 2.5
-1600	749	6	136.2	+ 8.0	-1400	-1200	0	7.6	+ 2.8
-1600	749	12	12.9	+ 7.9	-1400	-1200	6	4.0	+ 1.8
-1600	800	0	4.5	+ 2.1	-1400	-1000	0	13.6	+ 3.4
-1600	1000	0	4.2	+ 2.3	-1400	-1000	6	2.8	+ 1.7
-1600	1200	0	4.2	+ 1.6	-1400	-800	0	4.3	+ 2.1
-1600	1200	6	1.0	+ 1.6	-1400	-800	6	3.5	+ 1.9
-1600	1800	0	3.5	+ 1.9	-1400	-600	0	5.4	+ 2.1
-1600	2000	0	5.7	+ 1.8	-1400	-600	6	0.8	+ 1.4
-1600	2000	6	3.2	+ 1.6	-1400	-400	0	4.3	+ 1.9
-1600	2400	0	5.0	+ 1.7	-1400	-400	6	2.0	+ 1.4
-1600	2400	6	1.9	+ 1.6	-1400	-200	0	6.9	+ 2.4
-1585	1600	0	33.5	+ 3.9	-1400	-200	6	1.7	+ 1.4
-1585	1600	6	38.6	+ 4.2	-1400	0	0	1.7	+ 1.8
-1585	1600	12	32.2	+ 3.7	-1400	0	6	1.9	+ 1.7
-1568	-3184	0	2.2	+ 1.6	-1400	200	0	1.6	+ 1.8
-1550	-2200	0	81.9	+ 4.5	-1400	200	0	2.2	+ 1.8
-1550	-2200	6	42.4	+ 4.7	-1400	200	6	2.9	+ 1.7
-1550	-2200	12	16.5	+ 4.3	-1400	400	0	2.1	+ 1.8
-1550	-1200	0	41.6	+ 3.6	-1400	600	0	9.4	+ 2.8
-1550	-1200	6	6.9	+ 2.9	-1400	600	6	5.1	+ 1.9
-1550	-1200	12	5.3	+ 2.1	-1400	600	12	2.6	+ 1.9
-1536	1600	0	296.9	+ 8.0	-1400	800	0	4.4	+ 2.2
-1536	1600	6	316.0	+ 11.0	-1400	1000	0	9.0	+ 2.6
-1536	1600	12	327.8	+ 12.5	-1400	1000	6	6.8	+ 1.8
-1529	-2400	0	163.1	+ 5.3	-1400	1000	12	3.2	+ 2.0
-1529	-2400	6	25.5	+ 4.9	-1400	1200	0	3.5	+ 1.6
-1529	-2400	12	22.1	+ 4.3	-1400	1200	6	2.7	+ 1.5
-1525	2800	0	5.1	+ 1.8	-1400	1400	0	60.3	+ 6.2
-1525	2800	6	5.0	+ 2.0	-1400	1400	6	63.3	+ 6.8
-1400	-3000	0	8.4	+ 1.9	-1400	1400	12	14.2	+ 5.6
-1400	-2800	0	5.0	+ 2.3	-1400	1600	0	11.2	+ 2.8

Table E-1 (continued)

<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>		<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>	
<u>North</u>	<u>East</u>	(in.)	(pCi/g)		<u>North</u>	<u>East</u>	(in.)	(pCi/g)	
-1400	1600	6	9.6	± 2.7	-1267	1200	0	122.2	± 6.1
-1400	1600	12	5.3	± 2.3	-1267	1200	6	122.7	± 6.7
-1400	1800	0	5.8	± 1.9	-1267	1200	12	25.1	± 6.8
-1400	1800	6	4.0	± 2.0	-1249	-2559	6	28.8	± 6.3
-1400	2000	0	5.9	± 2.0	-1249	-2559	12	15.6	± 4.8
-1400	2000	6	4.2	± 2.0	-1238	-2599	6	23.7	± 4.0
-1388	-3340	0	1.2	± 1.4	-1238	-2599	12	10.2	± 3.6
-1326	1400	0	235.1	± 7.0	-1219	-3391	6	4.5	± 1.9
-1326	1400	6	259.5	± 6.5	-1218	-2994	6	11.5	± 3.0
-1326	1400	12	38.3	± 5.9	-1218	-2994	12	7.4	± 2.7
-1325	-2200	6	5.9	± 2.5	-1217	-3322	0	65.1	± 4.3
-1325	-2200	12	4.6	± 2.2	-1217	-3322	6	9.8	± 7.9
-1320	1575	0	315.7	± 8.8	-1217	-3322	12	6.5	± 2.6
-1320	1575	6	347.3	± 8.0	-1214	-3219	0	245.9	± 5.9
-1320	1575	12	654.0	± 12.7	-1213	-3194	0	81.0	± 4.9
-1300	-2459	6	166.3	± 9.5	-1213	-3194	6	73.1	± 4.7
-1300	-2459	12	89.8	± 7.1	-1213	-3194	12	98.4	± 5.5
-1300	-1200	0	9.7	± 2.3	-1213	-3176	0	521.5	± 9.4
-1300	-1200	6	3.6	± 2.0	-1213	-3176	6	450.5	± 11.0
-1300	-1000	0	5.1	± 2.4	-1213	-3176	12	1042.9	± 7.7
-1300	-1000	6	5.3	± 1.9	-1213	-3169	0	120.1	± 5.4
-1300	-1000	6	5.9	± 2.5	-1208	-2994	0	30.1	± 3.1
-1300	-1000	12	13.9	± 2.6	-1208	-2994	6	15.5	± 3.4
-1300	-800	0	16.5	± 2.9	-1208	-2994	12	5.3	± 2.6
-1300	-800	6	18.6	± 2.4	-1206	-2969	0	35.4	± 3.3
-1300	-800	12	23.7	± 3.2	-1201	1245	0	276.4	± 9.5
-1300	-600	0	5.6	± 2.6	-1201	1245	6	240.2	± 10.6
-1300	-600	6	3.5	± 1.5	-1201	1245	12	72.2	± 10.9
-1300	-400	0	5.4	± 2.2	-1200	-2400	0	6.1	± 2.3
-1300	-400	6	4.4	± 1.7	-1200	-2400	6	4.4	± 2.2
-1300	-200	0	7.1	± 2.4	-1200	-2200	0	4.5	± 2.3
-1300	-200	6	9.2	± 2.0	-1200	-2200	6	2.5	± 2.0
-1300	-200	12	11.5	± 2.5	-1200	-2000	0	5.5	± 2.4
-1300	0	0	2.8	± 1.7	-1200	-2000	6	4.0	± 2.0
-1300	0	6	2.2	± 1.7	-1200	0	0	3.9	± 1.9
-1295	1200	0	127.0	± 5.6	-1200	200	0	3.9	± 2.3
-1295	1200	6	54.8	± 5.8	-1200	400	0	2.4	± 1.6
-1295	1200	12	18.6	± 4.8	-1200	600	0	19.7	± 3.2
-1275	-2000	6	30.3	± 3.8	-1200	600	6	8.1	± 2.2
-1275	-2000	12	5.7	± 2.8	-1200	600	12	4.8	± 2.2
-1275	1025	0	248.8	± 7.1	-1200	800	0	46.4	± 4.9
-1275	1025	6	257.2	± 8.5	-1200	800	6	7.1	± 3.2
-1275	1025	12	83.0	± 8.9	-1200	800	12	5.5	± 2.9
-1269	-3313	0	81.0	± 4.2	-1200	820	0	142.1	± 7.5
-1269	-3313	6	2.4	± 3.9	-1200	820	6	31.5	± 6.4
-1269	-3313	12	5.7	± 2.3	-1200	820	12	8.8	± 5.0

Table E-1 (continued)

<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>		<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>	
<u>North</u>	<u>East</u>	(in.)	(pCi/g)		<u>North</u>	<u>East</u>	(in.)	(pCi/g)	
-1200	898	0	234.0	\pm 9.5	-1016	680	6	105.1	\pm 4.3
-1200	898	6	230.6	\pm 8.1	-1016	680	6	88.2	\pm 5.5
-1200	898	12	208.4	\pm 9.3	-1016	680	12	184.9	\pm 7.0
-1200	1000	0	38.3	\pm 7.1	-1015	-3199	0	0.8	\pm 1.7
-1200	1200	0	121.3	\pm 5.3	-1015	-3199	6	1.1	\pm 1.6
-1200	1200	6	102.4	\pm 5.9	-1009	-3000	0	19.1	\pm 3.5
-1200	1200	12	36.1	\pm 6.0	-1009	-3000	6	11.8	\pm 3.5
-1200	1400	0	22.7	\pm 3.2	-1009	-3000	12	2.5	\pm 2.3
-1200	1400	6	7.6	\pm 2.8	-1009	-2992	6	81.7	\pm 6.9
-1200	1400	12	7.4	\pm 2.7	-1009	-2992	12	55.8	\pm 5.8
-1200	1600	0	4.3	\pm 1.9	-1001	-2801	0	41.7	\pm 4.4
-1200	1600	6	3.5	\pm 1.9	-1001	-2801	6	16.5	\pm 4.3
-1200	1800	0	9.2	\pm 2.2	-1001	-2801	12	4.2	\pm 2.2
-1200	1800	6	3.1	\pm 1.7	-1000	-2400	0	63.5	\pm 4.2
-1200	2000	0	4.1	\pm 1.8	-1000	-2400	6	21.3	\pm 4.3
-1200	2000	6	4.4	\pm 1.9	-1000	-2400	12	13.2	\pm 4.0
-1198	-2601	0	17.4	\pm 2.8	-1000	-2300	0	74.6	\pm 4.6
-1198	-2601	6	2.6	\pm 2.2	-1000	-2300	6	17.1	\pm 4.5
-1198	-2581	0	8.3	\pm 2.1	-1000	-2300	12	5.3	\pm 3.4
-1198	-2581	6	3.7	\pm 2.5	-1000	-2200	0	15.6	\pm 2.7
-1197	-2797	0	7.8	\pm 2.5	-1000	-2200	6	11.9	\pm 2.7
-1197	-2797	6	3.6	\pm 2.1	-1000	-2200	12	2.6	\pm 2.4
-1197	-2679	0	31.4	\pm 3.2	-1000	-2000	0	23.1	\pm 3.1
-1197	-2679	6	13.6	\pm 3.1	-1000	-2000	6	19.4	\pm 3.0
-1197	-2679	12	3.4	\pm 2.5	-1000	-2000	12	5.1	\pm 2.6
-1190	730	0	121.9	\pm 6.8	-1000	-1800	0	3.5	\pm 2.1
-1190	730	6	98.1	\pm 6.6	-1000	-1800	6	1.0	\pm 1.8
-1190	730	12	25.3	\pm 6.8	-1000	0	0	16.0	\pm 2.9
-1120	790	0	117.4	\pm 5.6	-1000	0	6	22.4	\pm 3.3
-1120	790	6	55.6	\pm 6.7	-1000	0	12	35.3	\pm 3.8
-1120	790	12	24.0	\pm 6.6	-1000	50	0	279.8	\pm 9.7
-1117	-3296	6	230.2	\pm 8.6	-1000	200	0	18.7	\pm 3.2
-1117	-3296	12	194.8	\pm 6.1	-1000	200	6	35.0	\pm 3.5
-1075	52	0	277.2	\pm 11.0	-1000	200	12	69.1	\pm 4.8
-1028	-3597	6	8.1	\pm 2.1	-1000	400	0	10.9	\pm 2.2
-1028	-3597	12	15.5	\pm 2.6	-1000	400	6	3.7	\pm 1.7
-1027	49	0	260.4	\pm 10.3	-1000	600	0	11.3	\pm 2.7
-1026	-3538	6	29.8	\pm 3.5	-1000	600	6	15.2	\pm 2.6
-1026	-3538	12	30.7	\pm 3.7	-1000	600	6	14.5	\pm 3.0
-1022	-3400	12	48.5	\pm 4.1	-1000	600	12	15.0	\pm 3.0
-1021	-3400	6	57.3	\pm 4.4	-1000	800	0	13.7	\pm 3.0
-1021	-3385	6	65.4	\pm 6.1	-1000	800	6	17.2	\pm 3.1
-1021	-3385	12	47.9	\pm 4.4	-1000	800	12	6.5	\pm 2.5
-1018	-3300	6	162.3	\pm 7.6	-1000	1000	0	17.3	\pm 3.5
-1018	-3300	12	20.1	\pm 4.4	-1000	1200	0	33.8	\pm 3.0
-1016	680	0	50.7	\pm 4.5	-1000	1200	6	6.3	\pm 2.7

Table E-1 (continued)

<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>		<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>	
<u>North</u>	<u>East</u>	(in.)	(pCi/g)		<u>North</u>	<u>East</u>	(in.)	(pCi/g)	
-1000	1200	12	3.3 ± 2.3		-800	200	12	69.5 ± 5.8	
-1000	1400	0	2.1 ± 1.7		-800	400	0	3.9 ± 2.0	
-1000	1400	6	3.3 ± 1.8		-800	600	0	4.9 ± 2.4	
-1000	1600	0	2.8 ± 1.7		-800	600	6	3.8 ± 1.9	
-1000	1600	6	2.9 ± 1.8		-800	800	0	5.1 ± 2.3	
-1000	1800	0	2.3 ± 1.6		-800	800	6	4.9 ± 2.0	
-1000	1800	6	3.7 ± 1.8		-800	1000	0	4.4 ± 2.1	
-1000	2000	0	4.5 ± 1.7		-798	-2602	0	54.6 ± 5.2	
-1000	2000	6	2.8 ± 1.8		-798	-2602	6	69.8 ± 5.7	
-998	-2601	6	4.2 ± 2.0		-798	-2602	12	63.5 ± 4.4	
-998	-2601	12	5.1 ± 2.0		-734	-3611	0	252.2 ± 10.2	
-960	875	0	170.4 ± 7.5		-734	-3611	6	22.7 ± 7.1	
-960	875	6	116.1 ± 7.7		-734	-3611	12	12.3 ± 6.2	
-960	875	12	26.4 ± 5.6		-734	-3611	12	10.1 ± 4.1	
-925	-2000	6	28.1 ± 6.9		-657	-4017	6	618.1 ± 13.8	
-925	-2000	12	23.8 ± 5.7		-657	-4017	12	345.5 ± 11.9	
-925	-1800	6	154.2 ± 6.1		-656	-3816	6	67.7 ± 9.7	
-925	-1800	12	131.8 ± 7.3		-656	-3816	12	13.8 ± 5.9	
-850	-2200	6	53.8 ± 10.1		-646	-3817	6	2.1 ± 2.4	
-850	-2200	12	12.3 ± 6.1		-636	-3617	6	1.9 ± 1.6	
-846	-3481	6	9.4 ± 3.0		-632	-3517	6	39.8 ± 4.1	
-846	-3481	12	4.8 ± 2.6		-632	-3517	12	5.8 ± 3.1	
-841	-3811	0	2.7 ± 2.2		-628	44	0	118.0 ± 6.9	
-841	-3811	6	3.0 ± 1.9		-627	-3418	6	44.9 ± 4.2	
-836	-3708	6	39.3 ± 4.1		-627	-3418	12	98.7 ± 5.2	
-836	-3708	12	26.4 ± 5.1		-618	-3210	6	5.4 ± 2.1	
-831	-3605	6	12.4 ± 2.5		-604	-2800	6	95.1 ± 7.4	
-831	-3605	12	9.1 ± 2.6		-604	-2800	12	150.8 ± 6.8	
-830	-3580	6	8.4 ± 2.9		-600	-2660	6	114.9 ± 8.1	
-830	-3580	12	3.1 ± 2.6		-600	-2660	12	170.3 ± 6.7	
-825	545	0	174.4 ± 6.8		-600	0	0	25.2 ± 3.5	
-824	-3408	6	3.9 ± 2.0		-600	0	6	43.4 ± 4.0	
-815	-3205	6	6.5 ± 2.8		-600	0	12	59.4 ± 3.9	
-815	-3205	12	4.1 ± 2.3		-600	200	0	13.2 ± 3.0	
-810	-3065	6	50.3 ± 4.7		-600	200	6	4.3 ± 2.1	
-810	-3065	12	15.9 ± 3.5		-600	400	0	5.4 ± 2.5	
-808	-3005	6	6.8 ± 2.5		-600	400	6	4.2 ± 2.0	
-808	-3005	12	3.9 ± 1.9		-600	600	0	5.6 ± 2.3	
-802	-2806	6	52.1 ± 4.6		-600	600	6	4.6 ± 2.0	
-802	-2806	12	49.6 ± 4.2		-600	800	0	4.3 ± 2.2	
-800	0	0	21.2 ± 3.2		-600	1000	0	3.6 ± 2.2	
-800	0	6	16.3 ± 3.4		-598	-2600	6	6.3 ± 2.9	
-800	0	12	28.9 ± 3.8		-598	-2600	12	4.8 ± 2.4	
-800	62	0	90.4 ± 5.8		-597	-3419	6	40.5 ± 9.8	
-800	200	0	43.9 ± 4.3		-597	-3419	12	14.7 ± 5.3	
-800	200	6	69.7 ± 5.0		-456	-4024	0	4.7 ± 2.3	

Table E-1 (continued)

<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>		<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>	
<u>North</u>	<u>East</u>	(in.)	(pCi/g)		<u>North</u>	<u>East</u>	(in.)	(pCi/g)	
-456	-4014	0	11.9	+ 2.9	-209	-3038	6	3.2	+ 1.9
-456	-4014	6	2.7	+ 2.1	-200	0	0	8.1	+ 2.2
-455	-3993	6	83.2	+ 4.7	-200	0	6	10.8	+ 2.4
-455	-3993	12	10.2	+ 4.3	-200	0	12	13.7	+ 2.7
-447	-3823	6	8.5	+ 2.3	-200	200	0	14.9	+ 2.6
-447	-3823	9	5.7	+ 1.9	-200	200	6	3.6	+ 1.9
-433	-3622	6	39.2	+ 4.0	-200	400	0	6.0	+ 2.4
-433	-3622	12	5.1	+ 2.7	-200	400	6	4.1	+ 2.0
-433	-3608	6	125.4	+ 7.1	-200	600	0	9.3	+ 2.8
-433	-3608	12	7.7	+ 4.3	-200	600	6	4.8	+ 2.3
-428	-3427	0	6.8	+ 2.7	-200	800	0	2.5	+ 1.8
-416	-4021	6	320.9	+ 8.5	-179	-3239	6	418.6	+ 8.6
-416	-4021	12	385.4	+ 13.4	-179	-3239	12	483.1	+ 8.8
-400	0	0	46.8	+ 3.3	-119	-3241	6	40.3	+ 4.2
-400	0	6	62.4	+ 4.6	-119	-3241	12	2.1	+ 2.5
-400	0	12	66.8	+ 5.7	-47	-3857	6	293.8	+ 9.1
-400	200	0	15.3	+ 3.4	-47	-3857	12	208.8	+ 7.6
-400	200	6	2.4	+ 2.1	-47	-3857	18	13.2	+ 8.7
-400	400	0	9.1	+ 2.7	-46	-3842	0	1.6	+ 2.1
-400	400	6	2.6	+ 1.8	-46	-3842	6	2.9	+ 1.9
-400	600	0	7.4	+ 2.4	-37	-3644	0	3.8	+ 1.9
-400	600	6	3.9	+ 2.0	-37	-3644	6	3.0	+ 1.5
-400	800	0	4.8	+ 2.3	-28	-3445	0	15.5	+ 2.9
-400	1000	0	3.2	+ 1.7	-28	-3445	6	5.4	+ 2.1
-398	24	0	55.8	+ 6.1	-28	-3445	12	5.6	+ 2.2
-320	-3830	6	23.2	+ 3.5	-28	-3445	18	1.9	+ 1.7
-320	-3830	9	9.7	+ 2.8	-20	-3244	0	4.9	+ 1.6
-300*	3935*	0	63.4	+ 4.6	-20	-3244	6	4.4	+ 2.1
-300*	3935*	0	62.0	+ 4.3	-20	600	0	7.1	+ 2.2
-300*	3935*	6	18.2	+ 4.1	-20	600	6	5.1	+ 1.7
-300*	3935*	12	5.0	+ 3.3	-19	-400	0	5.1	+ 1.8
-246	-3863	6	199.9	+ 6.7	-10	-3050	6	3.4	+ 2.0
-246	-3863	9	317.1	+ 8.2	-10	-200	0	5.1	+ 2.2
-245	-3834	6	5.7	+ 2.1	0	-2800	0	7.9	+ 2.6
-245	-3834	9	9.0	+ 2.4	0	-2800	6	1.9	+ 1.8
-241	-3735	6	74.1	+ 4.5	0	-2600	0	28.0	+ 3.5
-241	-3735	12	71.3	+ 6.0	0	-2600	6	19.7	+ 3.1
-237	-3637	6	1.6	+ 1.8	0	-2600	12	14.1	+ 3.1
-231	-3497	6	50.0	+ 4.3	0	-2400	0	14.7	+ 3.1
-231	-3497	12	77.0	+ 4.8	0	-2400	6	13.4	+ 2.7
-229	-3437	6	15.3	+ 3.2	0	-2400	12	13.1	+ 2.9
-229	-3437	12	16.3	+ 2.4	0	-2200	0	26.0	+ 4.0
-219	-3247	6	236.5	+ 7.0	0	-2200	6	2.6	+ 2.1
-219	-3247	12	67.9	+ 6.1	0	-2000	0	3.7	+ 2.3
-219	-3237	6	99.6	+ 4.7	0	-1800	0	107.7	+ 9.2
-219	-3237	12	207.2	+ 5.4	0	-1800	6	10.8	+ 4.7

Table E-1 (continued)

<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>		<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>
<u>North</u>	<u>East</u>	(in.)	(pCi/g)		<u>North</u>	<u>East</u>	(in.)	(pCi/g)
0	-1800	12	3.2 ± 3.1		200	-2600	12	1.0 ± 2.2
0	-1600	6	4.5 ± 2.8		200	-2400	0	16.4 ± 3.1
0	-1200	0	18.9 ± 3.2		200	-2400	6	8.1 ± 2.6
0	-1200	6	2.7 ± 2.0		200	-2400	12	4.2 ± 2.0
0	-1000	0	11.4 ± 2.7		200	-2200	0	19.0 ± 3.4
0	-1000	6	1.4 ± 1.6		200	-2200	6	1.4 ± 1.8
0	-800	0	4.4 ± 2.3		200	-2000	0	36.6 ± 6.4
0	-600	0	15.5 ± 2.8		200	-2000	6	5.8 ± 2.8
0	-600	6	13.7 ± 2.6		200	-2000	12	0.3 ± 2.3
0	-600	12	3.1 ± 1.9		200	-1800	0	91.5 ± 6.6
0	1017	0	6.7 ± 2.1		200	-1800	6	157.2 ± 7.2
0	1017	6	4.4 ± 1.9		200	-1800	12	86.6 ± 7.4
0	1190	0	8.5 ± 2.6		200	-1600	0	34.9 ± 4.8
0	1190	6	5.1 ± 2.3		200	-1600	6	1.7 ± 2.4
0*	3925*	0	32.2 ± 3.3		200	200	0	8.6 ± 2.3
0*	3925*	6	9.9 ± 3.1		200	200	6	6.5 ± 2.1
0*	3925*	12	5.1 ± 2.9		200	200	12	7.2 ± 2.3
5	800	0	1.6 ± 1.6		200	-1400	0	4.8 ± 2.3
10	-1600	0	49.8 ± 5.4		200	-1200	0	6.8 ± 2.5
12	-1800	0	200.0 ± 10.7		200	-1200	6	4.4 ± 2.0
12	-1800	6	12.8 ± 3.9		200	-1000	0	6.3 ± 2.3
12	-1800	12	3.5 ± 3.0		200	-800	0	25.5 ± 3.3
12	400	0	2.6 ± 1.8		200	-800	6	13.4 ± 2.9
15	-1400	0	23.2 ± 4.2		200	-800	12	2.7 ± 2.2
15	-1400	6	5.0 ± 2.4		200	-600	0	5.3 ± 1.8
15	200	0	6.2 ± 2.3		200	-400	0	24.2 ± 3.4
20	0	0	0.8 ± 1.5		200	-400	6	5.2 ± 2.4
23	-2200	0	101.2 ± 6.6		200	-400	12	4.3 ± 2.2
23	-2200	6	4.6 ± 3.6		200	-200	0	17.6 ± 2.7
39	-400	0	31.0 ± 3.0		200	-200	6	5.0 ± 2.8
39	-400	6	21.9 ± 3.3		200	0	0	7.6 ± 3.1
39	-400	12	9.8 ± 3.1		200	0	6	2.0 ± 1.8
62	0	0	22.4 ± 3.9		200	400	0	10.2 ± 3.2
62	0	6	4.7 ± 2.1		200	400	6	2.4 ± 1.8
71	-2000	0	106.9 ± 6.8		200	600	0	2.0 ± 1.6
71	-2000	6	16.5 ± 4.6		200	800	0	5.6 ± 2.2
71	-2000	12	6.4 ± 3.2		200	1220	0	21.0 ± 3.3
100	-2750	0	138.3 ± 6.4		200	1220	0	24.3 ± 3.1
100	-2750	6	193.2 ± 7.7		200	1220	6	23.9 ± 3.2
100	-2750	12	4.9 ± 4.2		200	1220	12	16.1 ± 3.5
130	-1800	0	245.2 ± 10.5		210	-2000	0	62.4 ± 6.5
130	-1800	6	331.2 ± 10.6		229	-1000	0	35.6 ± 3.7
130	-1800	12	149.8 ± 10.0		229	-1000	6	46.5 ± 3.8
200	-2800	0	5.0 ± 2.3		229	-1000	12	52.3 ± 4.8
200	-2600	0	39.4 ± 4.2		296	600	0	17.8 ± 3.1
200	-2600	6	7.8 ± 2.9		296	600	12	5.0 ± 2.2

Table E-1 (continued)

<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>	<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>
<u>North</u>	<u>East</u>	(in.)	(pCi/g)	<u>North</u>	<u>East</u>	(in.)	(pCi/g)
340	-2610	0	1903.6 + 19.5	405	800	6	71.5 + 3.8
340	-2610	6	201.1 + 9.0	405	800	12	67.8 + 5.3
340	-2610	12	14.1 + 8.9	420	-2400	0	26.8 + 3.4
390	-1400	0	7.1 + 2.4	420	-2400	6	14.2 + 3.0
390	-1400	6	4.1 + 2.1	420	-2400	12	15.0 + 3.1
400	-2800	0	14.6 + 2.8	421	-1800	0	58.4 + 4.3
400	-2800	6	14.2 + 2.8	421	-1800	6	70.6 + 4.9
400	-2800	12	4.9 + 2.9	421	-1800	12	19.9 + 4.8
400	-2600	0	40.1 + 4.0	425	-2000	0	14.7 + 4.3
400	-2600	6	7.5 + 2.8	425	-2000	6	2.9 + 1.9
400	-2600	12	4.3 + 2.4	480	1000	0	50.0 + 4.5
400	-2400	0	7.8 + 2.3	480	1000	6	32.4 + 3.4
400	-2400	6	16.3 + 2.4	480	1000	12	5.2 + 3.2
400	-2400	12	13.7 + 2.9	480	1000	12	6.2 + 3.1
400	-2200	0	38.5 + 3.8	500	-2400	0	40.5 + 4.3
400	-2200	6	45.8 + 4.1	500	-2400	6	3.9 + 2.6
400	-2200	12	23.2 + 3.6	600	-2800	0	10.1 + 2.6
400	-1995	0	25.0 + 3.2	600	-2800	6	8.7 + 2.0
400	-1995	6	2.7 + 1.9	600	-2800	12	.6.3 + 2.5
400	-1800	0	23.2 + 3.1	600	-2600	0	7.9 + 2.6
400	-1800	6	2.7 + 2.2	600	-2600	6	1.3 + 1.7
400	-1600	0	11.4 + 3.4	600	-2200	0	7.7 + 2.0
400	-1600	6	4.2 + 2.3	600	-2200	6	1.5 + 1.7
400	-1200	0	5.9 + 2.3	600	-2000	0	15.5 + 3.3
400	-1000	0	9.4 + 2.3	600	-2000	6	6.7 + 2.4
400	-1000	6	4.3 + 2.1	600	-2000	12	2.5 + 1.9
400	-800	0	7.0 + 2.3	600	-1800	0	11.7 + 2.9
400	-800	6	3.2 + 1.6	600	-1800	6	12.4 + 2.5
400	-600	0	16.5 + 2.9	600	-1800	12	9.9 + 2.7
400	-600	6	1.0 + 1.7	600	-1600	0	9.2 + 3.6
400	-400	0	10.5 + 2.2	600	-1600	6	4.1 + 2.1
400	-400	6	1.8 + 1.6	600	-1400	0	13.5 + 2.6
400	-200	0	8.3 + 3.0	600	-1200	0	5.9 + 2.6
400	-200	6	3.1 + 1.8	600	-1200	6	4.5 + 2.0
400	0	0	4.2 + 2.0	600	-1000	0	8.5 + 2.5
400	200	0	4.0 + 1.7	600	-1000	6	1.5 + 1.6
400	400	0	7.0 + 2.6	600	-800	0	7.8 + 2.0
400	400	6	3.6 + 1.8	600	-800	6	2.9 + 2.0
400	600	0	8.7 + 2.6	600	-600	0	4.6 + 2.1
400	600	6	1.5 + 1.6	600	-400	0	2.1 + 1.6
400	800	0	7.9 + 2.6	600	-200	0	10.2 + 2.7
400	800	6	0.9 + 1.7	600	-200	6	2.7 + 1.7
400	1200	0	14.3 + 2.8	600	0	0	9.3 + 2.7
400	1200	6	6.3 + 2.7	600	0	6	1.3 + 1.7
400	1200	12	3.9 + 2.7	600	200	0	5.7 + 2.3
405	800	0	47.8 + 4.4	600	400	0	1.2 + 1.5

Table E-1 (continued)

<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>	<u>Coordinates</u>		<u>Depth</u>	<u>eRa-226</u>
<u>North</u>	<u>East</u>	(in.)	(pCi/g)	<u>North</u>	<u>East</u>	(in.)	(pCi/g)
600	600	0	4.1 ± 2.0	1000	-2200	6	7.3 ± 2.3
603	-2400	0	19.7 ± 3.1	1000	-2000	0	10.4 ± 2.4
603	-2400	6	17.9 ± 3.0	1000	-2000	0	8.1 ± 2.0
603	-2400	12	5.1 ± 2.3	1000	-1800	0	7.8 ± 2.4
632	-2611	0	98.1 ± 4.6	1000	-1400	0	12.1 ± 2.6
632	-2611	6	103.8 ± 6.1	1000	-1000	0	3.3 ± 2.0
632	-2611	12	70.2 ± 6.4	1000	-800	0	4.4 ± 2.0
694	-1800	0	29.3 ± 4.3	1000	-600	0	4.6 ± 2.2
694	-1800	6	8.5 ± 3.2	1000	-400	0	9.5 ± 2.3
796	-1600	0	4.5 ± 1.8	1000	-400	6	3.1 ± 2.0
800	-2800	0	9.4 ± 2.5	1000	-200	0	6.2 ± 2.1
800	-2800	6	13.5 ± 2.4	1000	0	0	6.7 ± 2.1
800	-2800	12	27.6 ± 3.1	1000	0	0	5.7 ± 2.1
800	-2600	0	1.5 ± 1.6	1000	0	6	3.1 ± 1.6
800	-2200	0	4.9 ± 2.5	1000	200	0	3.1 ± 1.7
800	-2000	0	4.0 ± 1.8	1100	-2200	0	7.8 ± 2.6
800	-1800	0	18.2 ± 3.3	1200	-2200	0	7.8 ± 2.4
800	-1800	6	4.1 ± 1.8	1200	-2000	0	8.5 ± 2.4
800	-1000	0	8.5 ± 2.3	1200	-2000	6	3.4 ± 1.7
800	-1000	6	4.6 ± 1.8	1200	-1800	0	9.9 ± 2.5
800	-800	0	4.7 ± 2.2	1200	-1800	6	7.4 ± 1.9
800	-600	0	5.6 ± 2.1	1200	-1400	0	6.4 ± 2.5
800	-400	0	4.3 ± 1.8	1200	-200	0	7.0 ± 1.7
800	-200	0	7.9 ± 2.7	1200	-200	6	4.0 ± 2.0
800	-200	6	1.9 ± 1.6	1400	-2200	0	7.1 ± 2.4
800	0	0	4.3 ± 1.9	1400	-2000	0	9.7 ± 2.3
800	0	0	6.6 ± 2.4	1400	-2000	0	5.6 ± 2.4
800	0	6	3.3 ± 1.6	1400	-1800	0	8.9 ± 2.0
800	200	0	5.3 ± 2.1	1400	-1400	0	5.7 ± 2.4
800	400	0	3.0 ± 1.7	1400	-1400	6	7.3 ± 2.3
800	600	0	6.3 ± 2.3	1400	-1400	12	5.0 ± 2.4
885°	4300°	0	31.6 ± 3.1	1500	-2200	0	11.3 ± 2.5
885°	4300°	6	18.3 ± 3.4	1870	-1900	0	3.7 ± 3.3
885°	4300°	12	11.1 ± 3.4	1870	-1800	0	6.1 ± 2.3
1000	-2200	0	9.2 ± 2.6				

Appendix F

BACKGROUND-MEASUREMENT DATA

Table F-1 presents analytical and measurement data obtained at the four background locations indicated in Figure 1. The MMJ number is the sample number. Radium, thorium, and potassium values represent equivalent concentrations. Exposure-rate and delta-gamma data are the averages of readings taken at each of the two points at the background locations (cf. Section 3.6). No logging results are presented for the West Background area since no boreholes were drilled in that area.

Table F-1
Background-Location Analytical and Measurement Data

Area	Depth (in.)	Exposure Rate		Delta		Spectrometer Results			MMU No.	Laboratory Results			Lossing Results		
		PIC Surface Surface --- --- (μ R/h)	SC-132 Surface Waist --- --- (μ R/h)	Readings	Radium (pCi/g)	Radium (pCi/g)	Thorium (ppm)	Potassium (%)		Radium (pCi/g)	Thorium (ppm)	Potassium (%)	Radium (pCi/g)	Bore- hole No.	
West	0	16	13	13	1.1 ± 0.3	1 ± 0.3	9 ± 0.6	1.9 ± 0.1	95 96	1 ± 1.0	1 ± 1.0	1.6 ± 0.2	1.4 ± 0.3	101	
	0	16	13	13	1.3 ± 0.5	1 ± 0.2	10 ± 0.6	1.9 ± 0.1		1 ± 1.0	4 ± 1.0	1.8 ± 0.3			
	0-6														
	0-6														
East	0	14	14	13	1.3 ± 0.1	2 ± 0.3	10 ± 0.7	2.0 ± 0.1	259 260 625	1 ± 1.0	2 ± 0.0	1.6 ± 0.4	1.4 ± 0.3	101	
	0	14	14	13	1.1 ± 0.7	1 ± 0.3	9 ± 0.7	2.0 ± 0.1		1 ± 1.0	2 ± 0.0	1.1 ± 0.3			
	0-6														
	0-6														
	0-14									1 ± 1.0					
South	0	15	13	13	1.5 ± 1.0	1 ± 0.3	10 ± 0.7	2.3 ± 0.1	567 568 676	1 ± 1.0	6 ± 2.0	2.1 ± 0.5	1.6 ± 0.4	100	
	0	15	13	13	1.5 ± 1.5	2 ± 0.3	9 ± 0.7	2.2 ± 0.1		1 ± 1.0	9 ± 2.0	1.8 ± 0.4			
	0-6														
	0-6														
	0-30									1 ± 1.0					
North	0	14	13	13	2.6 ± 0.9	1 ± 0.3	13 ± 0.8	2.2 ± 0.1	723 724 727 725	2 ± 1.0	7 ± 1.0	2.2 ± 0.2	1.7 ± 0.4	43	
	0	15	13	13	1.2 ± 1.0	1 ± 0.3	10 ± 0.7	2.2 ± 0.1		1 ± 1.0	9 ± 2.0	2.4 ± 0.2			
	0-6														
	0-6														
	0-21									1 ± 1.0	5 ± 1.0	2.1 ± 0.3			
Average		15	13	13	1.5	1	10	2.1		4.5	1	5	1.9	1.6	

Appendix G

EXPOSURE-RATE MEASUREMENT DATA

Table G-1 presents results of the exposure-rate measurements taken with Mount Sopris SC-132 scintillometers. These data were generated by the computer program EXPOCALC.BAS, Version 1.0. An asterisk (*) indicates that approximate coordinates were assigned to the measurement location because it falls outside the surveyed area.

Paired pressurized-ionization-chamber (PIC) and scintillometer measurements are listed in Table G-2 and plotted on Figure G-1. These data were used to convert the raw scintillometer measurements to the exposure-rate readings found in Table G-1. The unit number is the GJO number for each scintillometer.

Table G-1

Exposure-Rate Survey Data

Grid Coordinates		Surface Reading ($\mu\text{R}/\text{h}$)	Waist-High Reading ($\mu\text{R}/\text{h}$)	Grid Coordinates		Surface Reading ($\mu\text{R}/\text{h}$)	Waist-High Reading ($\mu\text{R}/\text{h}$)
North	East			North	East		
-33924*	20338*	10	10	-2630	-800	14	14
-33924*	20328*	10	10	-2630	-600	15	14
-4870*	13000*	27	29	-2625	-400	14	14
-4670*	13120*	12	13	-2625	-200	14	14
-3050*	11670*	11	11	-2625	0	15	14
-2850	-2585	16	15	-2615	-2000	105	75
-2800	-2000	16	16	-2610	-2690	11	11
-2800	-1600	14	14	-2610	-2359	78	42
-2800	-1200	14	14	-2610	-2300	229	99
-2800	-400	13	13	-2600	-2600	13	14
-2800	200	13	13	-2600	-2400	19	19
-2800	400	12	14	-2600	-2200	16	17
-2800	800	13	13	-2600	-2100	206	42
-2766	6000	16	17	-2600	-2000	34	33
-2716	6000	105	66	-2600	-1800	20	26
-2681	6000	159	92	-2600	-1600	52	34
-2640	-2440	90	35	-2600	-1555	621	253
-2640	-2200	17	17	-2600	-1400	38	37
-2640	-1200	65	45	-2600	-1400	0	42
-2635	-2400	73	48	-2600	-1370	454	152
-2632	-2000	149	99	-2600	-1280	259	119
-2631	6000	16	17	-2600	-1200	30	33
-2630	-2000	72	62	-2600	-1135	159	78
-2630	-1970	769	68	-2600	-1000	19	19
-2630	-1800	34	28	-2600	-800	16	16
-2630	-1600	31	29	-2600	-600	16	16
-2630	-1535	246	51	-2600	-400	16	16
-2630	-1400	21	21	-2600	-200	15	15
-2630	-1245	133	56	-2600	0	15	15
-2630	-1200	64	42	-2600	200	19	16
-2630	-1000	15	15	-2595	-1700	333	72

Table G-1 (continued)

<u>Grid Coordinates</u>		<u>Surface Reading</u> ($\mu\text{R}/\text{h}$)	<u>Waist-High Reading</u> ($\mu\text{R}/\text{h}$)	<u>Grid Coordinates</u>		<u>Surface Reading</u> ($\mu\text{R}/\text{h}$)	<u>Waist-High Reading</u> ($\mu\text{R}/\text{h}$)
<u>North</u>	<u>East</u>			<u>North</u>	<u>East</u>		
-2583	-2000	132	58	-2202	4000	14	14
-2573	5200	17	18	-2200	-2600	16	16
-2525	-2200	65	55	-2200	-2452	413	75
-2523	-1600	266	112	-2200	-2400	17	18
-2518	-2400	226	88	-2200	-2325	166	65
-2478	5200	25	25	-2200	-2200	27	23
-2460	-1800	68	38	-2200	-2168	57	52
-2450	-2200	527	172	-2200	-2000	20	20
-2433	5600	15	15	-2200	-1600	18	19
-2410	-2760	12	12	-2200	-1400	22	22
-2402	5600	25	23	-2200	-1200	17	18
-2400	-2600	16	16	-2200	-1140	139	78
-2400	-2460	594	192	-2200	-1000	25	26
-2400	-2400	22	21	-2200	-800	34	27
-2400	-2320	802	152	-2200	-600	18	18
-2400	-2200	65	42	-2200	-400	17	17
-2400	-2050	34	29	-2200	-200	15	15
-2400	-2000	17	18	-2200	0	15	15
-2400	-1954	105	45	-2200	200	16	15
-2400	-1800	17	18	-2195	-1475	253	78
-2400	-1700	159	92	-2160	-2600	40	29
-2400	-1614	92	34	-2144	4800	15	15
-2400	-1600	17	19	-2135	4400	15	15
-2400	-1400	17	18	-2132	3600	15	14
-2400	-1200	40	32	-2112	2400	14	14
-2400	-1000	21	21	-2110	4400	17	17
-2400	-800	19	19	-2104	-1585	58	38
-2400	-600	19	17	-2102	4000	25	20
-2400	-400	16	16	-2100	4380	122	50
-2400	-200	16	16	-2092	-1200	84	52
-2400	0	15	15	-2060	-2404	117	38
-2400	200	14	13	-2052	2200	19	18
-2400	400	15	14	-2040	-2000	527	179
-2389	4800	15	16	-2034	4000	18	16
-2379	-1200	86	44	-2000	-2980	12	12
-2378	5200	15	15	-2000	-2800	13	14
-2373	5600	12	12	-2000	-2600	21	21
-2369	-1600	182	65	-2000	-2400	18	17
-2304	4800	45	33	-2000	-2200	30	25
-2271	-2400	58	29	-2000	-2075	55	44
-2270	4800	65	39	-2000	-2000	18	21
-2261	-1400	125	72	-2000	-1969	122	119
-2244	4800	15	18	-2000	-1800	15	16
-2210	-2880	12	12	-2000	-1600	18	18
-2207	-1800	38	25	-2000	-1400	25	21

Table G-1 (continued)

<u>Grid Coordinates</u>		<u>Surface Reading</u>	<u>Waist-High Reading</u>	<u>Grid Coordinates</u>		<u>Surface Reading</u>	<u>Waist-High Reading</u>
<u>North</u>	<u>East</u>	($\mu\text{R}/\text{h}$)	($\mu\text{R}/\text{h}$)	<u>North</u>	<u>East</u>	($\mu\text{R}/\text{h}$)	($\mu\text{R}/\text{h}$)
-2000	-1265	55	40	-1800	-1000	17	19
-2000	-1200	21	23	-1800	-800	15	15
-2000	-1145	259	52	-1800	-600	17	17
-2000	-1000	21	23	-1800	-400	16	16
-2000	-800	21	20	-1800	-200	18	17
-2000	-600	21	19	-1800	0	17	16
-2000	-400	15	15	-1800	200	13	14
-2000	-200	15	15	-1800	2000	17	17
-2000	0	17	16	-1785	1600	18	18
-2000	200	12	14	-1740	-2200	209	112
-2000	1400	14	15	-1738	1800	16	15
-1993	2200	21	18	-1735	2600	42	23
-1973	3600	15	17	-1725	2800	15	15
-1950	4380	14	14	-1722	2000	15	15
-1944	-1000	172	58	-1700	-3260	11	11
-1940	2000	17	16	-1600	-3000	15	14
-1934	4000	14	14	-1600	-2800	14	14
-1933	3200	14	14	-1600	-2600	21	20
-1920	3000	16	17	-1600	-2400	22	20
-1912	2400	18	17	-1600	-2330	132	55
-1892	-2000	78	52	-1600	-2200	23	23
-1887	3000	60	48	-1600	-2000	23	23
-1885	1600	15	15	-1600	-1800	23	24
-1873	2400	52	26	-1600	-1600	23	23
-1872	3400	29	30	-1600	-1400	35	30
-1858	3400	55	42	-1600	-1200	26	26
-1856	-2200	179	75	-1600	-1000	26	23
-1844	3200	19	18	-1600	-800	21	20
-1835	2800	15	15	-1600	-600	15	15
-1822	2000	21	19	-1600	-400	17	17
-1821	-2410	186	95	-1600	-200	17	17
-1800	-3120	12	12	-1600	0	17	17
-1800	-3000	12	12	-1600	200	16	16
-1800	-2800	16	16	-1600	400	14	15
-1800	-2600	16	16	-1600	600	15	15
-1800	-2500	47	38	-1600	749	106	67
-1800	-2400	20	25	-1600	750	89	60
-1800	-2350	259	105	-1600	800	18	18
-1800	-2200	38	38	-1600	1000	16	16
-1800	-2000	21	23	-1600	1200	22	21
-1800	-1800	20	20	-1600	1800	17	17
-1800	-1600	30	32	-1600	2000	15	14
-1800	-1550	269	139	-1600	2400	16	17
-1800	-1400	112	78	-1585	1600	48	45
-1800	-1200	18	20	-1568	-3184	14	14

Table G-1 (continued)

Grid Coordinates		Surface Reading ($\mu\text{R}/\text{h}$)	Waist-High Reading ($\mu\text{R}/\text{h}$)	Grid Coordinates		Surface Reading ($\mu\text{R}/\text{h}$)	Waist-High Reading ($\mu\text{R}/\text{h}$)
North	East			North	East		
-1560	-3340	12	11	-1300	-200	19	19
-1550	-2200	85	45	-1300	0	15	16
-1550	-1200	57	44	-1295	1200	129	87
-1536	1600	233	132	-1275	-2000	42	38
-1529	-2400	145	34	-1275	1025	161	150
-1525	2800	16	15	-1270	-3640	13	12
-1430	-1200	85	125	-1269	-3320	172	862
-1400	-3000	18	18	-1267	1200	110	84
-1400	-2800	17	17	-1254	-2559	72	0
-1400	-2600	19	20	-1249	-2559	172	0
-1400	-2450	72	52	-1238	-2599	85	72
-1400	-2400	21	21	-1219	-3391	21	21
-1400	-2305	38	38	-1218	-3341	58	340
-1400	-2200	25	24	-1218	-2994	45	0
-1400	-2000	42	38	-1217	-3322	72	628
-1400	-1200	39	52	-1214	-3219	192	192
-1400	-1000	32	27	-1213	-3194	92	92
-1400	-800	20	21	-1213	-3176	206	206
-1400	-600	20	20	-1213	-3169	92	85
-1400	-400	17	16	-1208	-2994	40	40
-1400	-200	17	16	-1206	-2969	40	44
-1400	0	15	16	-1201	1245	231	189
-1400	200	14	17	-1200	-2400	26	24
-1400	400	15	16	-1200	-2200	21	21
-1400	588	0	30	-1200	-2000	23	23
-1400	600	21	22	-1200	0	19	20
-1400	800	17	18	-1200	200	16	17
-1400	1000	22	22	-1200	400	13	13
-1400	1200	23	23	-1200	600	25	26
-1400	1400	99	88	-1200	800	75	68
-1400	1600	37	40	-1200	820	115	82
-1400	1800	18	18	-1200	898	168	142
-1400	2000	18	16	-1200	900	168	122
-1392	-3188	14	14	-1200	960	40	42
-1388	3340	15	17	-1200	1000	39	36
-1326	1400	179	112	-1200	1200	121	107
-1325	-2449	206	0	-1200	1400	40	38
-1325	-2200	35	32	-1200	1600	21	21
-1320	1575	293	219	-1200	1800	24	21
-1300	-2459	306	0	-1200	2000	16	16
-1300	-1200	27	30	-1198	-2601	30	32
-1300	-1000	21	20	-1198	-2581	32	32
-1300	-800	21	20	-1197	-2797	25	23
-1300	-600	19	19	-1197	-2679	43	28
-1300	-400	17	17	-1190	730	91	62

Table G-1 (continued)

Grid Coordinates		Surface Reading ($\mu\text{R}/\text{h}$)	Waist-High Reading ($\mu\text{R}/\text{h}$)	Grid Coordinates		Surface Reading ($\mu\text{R}/\text{h}$)	Waist-High Reading ($\mu\text{R}/\text{h}$)
North	East			North	East		
-1120	790	98	77	-850	-2200	541	340
-1117	-3296	99	0	-850	-1800	72	65
-1100	0	42	47	-846	-3481	42	40
-1075	52	226	157	-841	-3811	18	19
-1028	-3597	21	21	-836	-3708	85	85
-1027	49	201	136	-831	-3605	28	35
-1026	-3538	38	37	-830	-3580	64	64
-1022	-3400	37	37	-825	545	96	40
-1021	-3385	65	434	-824	-3408	25	24
-1018	-3300	92	99	-815	-3205	25	25
-1016	680	44	45	-810	-3065	45	33
-1015	-3199	21	28	-808	-3005	22	21
-1009	-3000	32	35	-802	-2806	45	43
-1009	-2992	125	125	-802	258	90	70
-1001	-2801	45	44	-800	0	34	35
-1000	-2400	72	58	-800	62	72	75
-1000	-2300	94	78	-800	200	45	41
-1000	-2200	35	37	-800	255	91	70
-1000	-2000	42	42	-800	400	17	19
-1000	-1800	30	32	-800	600	17	17
-1000	0	28	33	-800	800	15	15
-1000	50	194	129	-800	1000	14	14
-1000	200	28	26	-798	-2602	26	25
-1000	400	20	19	-734	-3611	179	166
-1000	550	53	44	-700	0	28	33
-1000	600	21	22	-657	-4017	45	41
-1000	665	0	35	-656	-3816	239	206
-1000	800	24	23	-647	-3837	133	132
-1000	910	93	43	-646	-3817	35	38
-1000	965	150	65	-636	-3617	27	31
-1000	1000	32	26	-632	-3517	78	46
-1000	1200	40	32	-628	-3418	407	407
-1000	1400	16	17	-628	44	90	68
-1000	1600	15	15	-627	-3418	65	132
-1000	1800	14	14	-624	-3340	72	72
-1000	2000	14	13	-623	-3418	675	407
-998	-2601	25	28	-618	-3210	23	23
-998	962	161	72	-610	-2974	25	25
-960	-1800	172	139	-604	-2800	155	125
-960	875	103	49	-600	-2660	139	139
-925	-2000	306	273	-600	0	38	42
-925	-1800	112	98	-600	200	26	26
-900	-2400	72	72	-600	400	19	17
-875	-1800	85	72	-600	600	16	15
-875	1000	15	16	-600	800	14	14

Table G-1 (continued)

<u>Grid Coordinates</u>		<u>Surface Reading</u>	<u>Waist-High Reading</u>	<u>Grid Coordinates</u>		<u>Surface Reading</u>	<u>Waist-High Reading</u>
<u>North</u>	<u>East</u>	($\mu\text{R}/\text{h}$)	($\mu\text{R}/\text{h}$)	<u>North</u>	<u>East</u>	($\mu\text{R}/\text{h}$)	($\mu\text{R}/\text{h}$)
-600	1000	14	13	0	-2800	24	27
-598	-2600	37	42	0	-2600	36	14
-597	-3419	273	239	0	-2400	30	33
-500	0	175	94	0	-2200	38	54
-456	-4024	20	20	0	-2000	28	32
-455	-3993	56	56	0	-1800	129	108
-447	-3823	18	25	0	-1600	80	73
-433	-3622	48	48	0	-1400	47	47
-433	-3608	206	206	0	-1200	33	31
-428	-3427	26	28	0	-1000	21	25
-416	-4021	65	62	0	-800	18	19
-400	0	50	46	0	-600	21	20
-400	200	27	26	0	-200	14	14
-400	400	19	19	0	400	12	13
-400	600	17	15	0	600	12	13
-400	800	15	15	0*	3925*	36	25
-400	1000	13	13	5	800	12	11
-398	24	72	60	15	200	16	15
-357	26	138	108	20	0	12	14
-320	-3830	48	45	39	-400	31	28
-246	-3863	125	125	62	0	31	28
-245	-3834	22	21	100	-2750	98	66
-241	-3735	52	26	200	-2800	19	19
-237	-3637	20	21	200	-2600	40	33
-234	-3236	72	72	200	-2400	30	28
-231	-3497	55	58	200	-2200	31	33
-229	-3437	38	45	200	-2000	74	73
-219	-3247	112	112	200	-1800	74	72
-219	-3237	47	45	200	-1600	56	51
-200	0	20	20	200	-1400	24	24
-200	200	26	24	200	-1200	19	19
-200	400	18	18	200	-1000	17	18
-200	600	20	18	200	-800	26	25
-200	800	13	13	200	-600	15	16
-179	-3239	233	206	200	-400	23	21
-119	-3241	32	28	200	-200	18	19
-85	-3045	52	32	200	0	26	24
-47	-3857	172	172	200	200	17	17
-46	-3842	25	33	200	400	16	17
-37	-3644	37	30	200	600	12	12
-28	-3445	28	25	200	800	14	14
-20	-3244	20	20	200	1220	24	21
-10	-3050	21	21	229	-1000	35	31
-10	-400	14	15	296	600	21	21
-1	-2850	26	28	340	-2610	479	72

Table G-1 (continued)

<u>Grid Coordinates</u>		<u>Surface Reading</u>	<u>Waist-High Reading</u>	<u>Grid Coordinates</u>		<u>Surface Reading</u>	<u>Waist-High Reading</u>
<u>North</u>	<u>East</u>	($\mu\text{R}/\text{h}$)	($\mu\text{R}/\text{h}$)	<u>North</u>	<u>East</u>	($\mu\text{R}/\text{h}$)	($\mu\text{R}/\text{h}$)
390	-1400	19	18	800	-2200	21	19
400	-2800	19	19	800	-2000	14	16
400	-2610	38	31	800	-1800	31	26
400	-2400	19	21	800	-1600	16	16
400	-2200	34	31	800	-1000	14	15
400	-2000	33	31	800	-800	14	14
400	-1800	24	24	800	-600	14	14
400	-1600	44	35	800	-400	14	13
400	-1000	16	15	800	-200	19	17
400	-800	17	16	800	0	14	14
400	-600	21	21	800	200	16	16
400	-400	23	21	800	400	13	14
400	-200	21	20	800	600	14	13
400	0	17	16	885*	4300*	31	21
400	200	13	15	1000	-2200	19	17
400	400	14	14	1000	-2000	17	17
400	600	15	15	1000	-1800	16	16
400	800	17	17	1000	-1600	16	16
400	1200	17	17	1000	-1400	19	17
405	800	40	24	1000	-1200	17	16
480	1000	33	31	1000	-1000	12	12
525	-2800	87	49	1000	-800	12	12
600	-2800	22	24	1000	-600	12	14
600	-2600	22	27	1000	-400	14	14
600	-2400	33	30	1000	-200	12	12
600	-2200	17	23	1000	0	12	12
600	-2000	24	22	1000	200	12	12
600	-1800	20	20	1000	400	12	11
600	-1600	26	26	1200	-2200	16	15
600	-1200	19	19	1200	-2000	16	16
600	-1000	18	17	1200	-1800	17	16
600	-800	16	16	1200	-1600	17	17
600	-600	14	14	1400	-2200	15	15
600	-400	12	13	1400	-2000	16	16
600	-200	19	18	1400	-1800	16	16
600	0	19	16	1400	-1600	15	15
600	200	17	15	1600	-2200	17	16
600	400	12	12	1600	-2000	16	16
600	600	13	13	1600	-1800	14	14
600	600	12	12	1600	-1600	14	14
632	-2611	73	58	1870	-2200	17	14
694	-1800	35	33	1870	-2000	16	14
800	-2800	19	19	1870	-1800	14	14
800	-2600	14	15	1870	-1600	14	14

Table G-2

Correlation Between PIC and SC-132 Exposure-Rate Measurements

<u>Measurement Location</u>	PIC Reading (μ R/h)	Scintillometer Reading (cps)	Unit	Unit
		C1098		C1164
BACKGROUND				
West	16.0	100		100
West	16.1	92		94
East	14.2	108		106
East	14.4	110		106
South	14.5	105		105
South	14.9	103		104
North	14.4	102		100
North	14.5	102		100
GRID COORDINATES				
North	East			
-1198	-2601	31.9	400	400
-1200	-2400	22.6	300	275
-1000	-2300	78.8	1060	1100
-1000	-2400	52.2	720	800
-1198	-2581	28.5	380	400
-1000	-2200	30.0	480	425
-850	-1800	76.7		900
-875	-1800	81.3		1000
-925	-1800	99.9	1360	1200
-960	-1800	130.4		2000
-1000	-1800	30.1	410	400
-1208	-2994	39.6	500	520
-179	-3239	94.7	1240	
-20	-3244	19.5	235	225
-2600	-2100	38.9		560
-2600	-1200	35.8		385
-2600	-1400	38.4		550
-2595	-1700	83.8		1000
-800	800	18.4	155	
-875	1000	17.2	175	
-600	200	26.2	320	

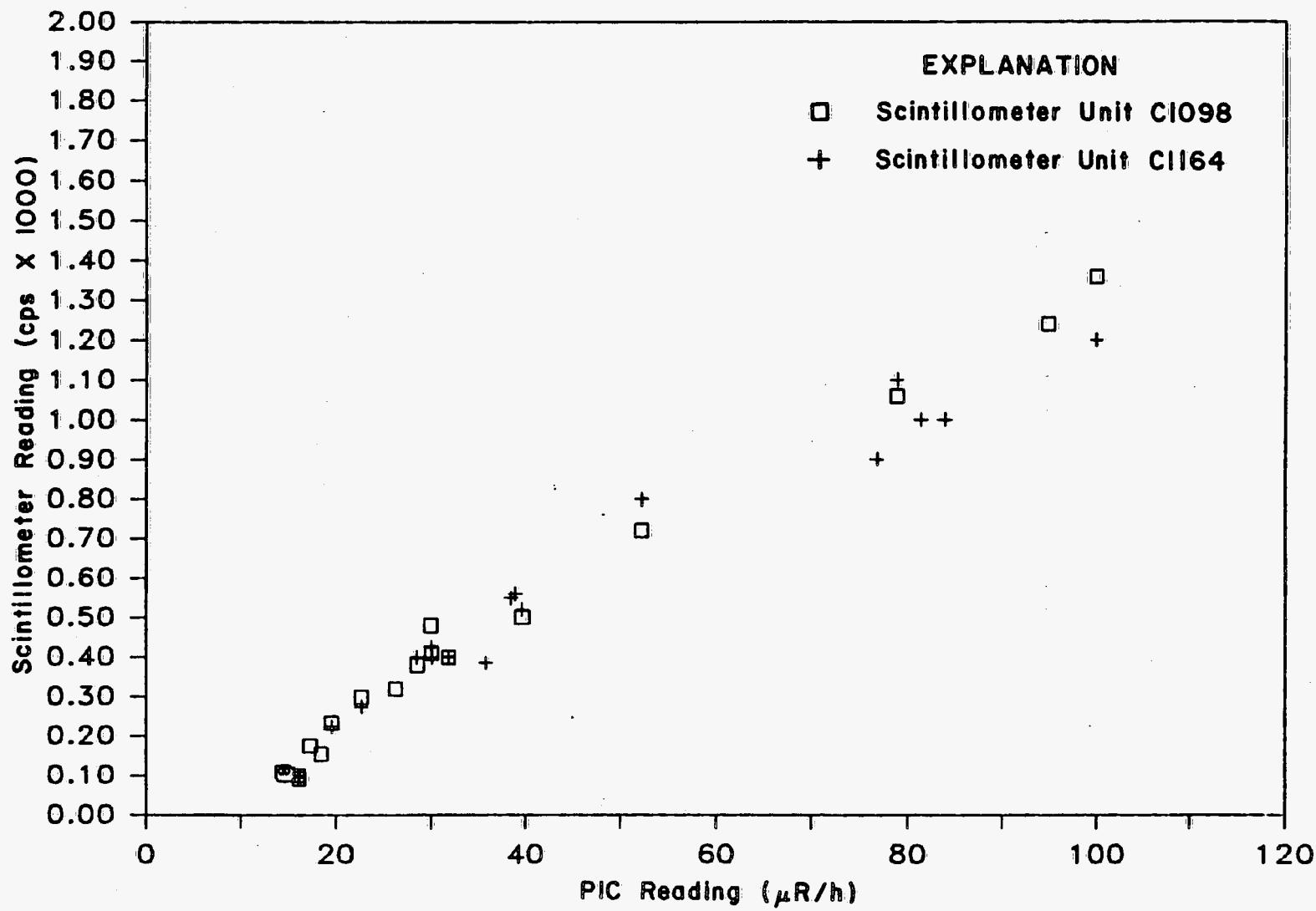


Figure G-1. Scatter Plot of PIC/Scintillometer Correlation Data

Appendix H

BOREHOLE GEOPHYSICAL LOGS AND DATA

The total-count RASCAL (PRS-1/SPA-3) system was used to log the boreholes in the Monticello peripheral properties study area. Borehole data are presented in Table H-1; the maximum depth at which contamination exceeds 6 and 16 pCi(Ra-226)/g, respectively, for each borehole is cited. Equipment characteristics and calibration information are included to document the parameters used in data reduction.

Uncertainties for the total-count system were calculated at a 95 percent confidence level (2σ). Water was encountered in two of the boreholes; for dry boreholes, the fluid-level depth shown on the log is 99.0 ft, a default value. No augers were used.

Radiometric logs for each of the boreholes may be found on microfiche in the pocket below.

Table H-1
Borehole Data from Total-Count System

EQUIPMENT DATA

INSTRUMENT	PRS-1 RASCAL	CASING THICKNESS	0 in.
GJO NUMBER	C-3572	CASING FACTOR	1.000 ± 0.000
SERIAL NUMBER	753	FLUID FACTOR	1.077 ± 0.054
DECTECTOR	NaI(Tl)	MOISTURE FACTOR	1.114 ± 0.049
DETECTOR SIZE	2 in. x 2 in.	K FACTOR	77.97 ± 1.87 g-cps/pCi(Ra226)
PROBE DIAMETER	2.5 in.	BACKGROUND	148.76 ± 89.28 cps
HOLE DIAMETER	5.5 in.	ALPHA FACTOR	2.95 ± 0.29 ft ⁻¹
CALIBRATION DATE	10 July 1984		

Hole No.	Grid Coordinates		Elevation (ft)	Log Depth (ft)	Maximum Depth of Ra-226 Contamination (ft):	
	North	East			>6 pCi/g	>16 pCi/g
MON-1	0.0	-2400.0	6934.6	4.7	2.0	2.0
MON-2	1000.0	-2200.0	7011.7	4.4	0.5	0
MON-3	1000.0	-2000.0	7008.7	4.5	0	0
MON-4	694.0	-1800.0	6986.0	1.9	0.5	0
MON-5	600.0	-1800.0	6970.5	2.3	0	0
MON-6	39.0	-400.0	6893.3	1.9	1.0	0.5
MON-7	600.0	-2800.0	6987.0	6.3	4.5	0
MON-8	800.0	-2800.0	6983.7	4.5	1.5	1.5
MON-9	632.0	-2611.0	6958.6	6.0	4.5	4.5
MON-10	405.0	800.0	6890.4	4.3	1.5	1.0
MON-11	200.0	1220.0	6889.0	2.0	0	0
MON-12	130.0	-1800.0	6897.0	3.3	>3.3	1.5
MON-13	229.0	-1000.0	6897.8	4.3	2.0	1.5
MON-14	-2635.0	-2440.0	7007.2	3.8	1.0	0.5
MON-15	-2518.0	-2400.0	7001.9	3.3	1.0	1.0
MON-16	-2610.0	-2300.0	6989.0	4.0	1.5	1.0
MON-17	-2525.0	-2200.0	6980.3	6.3	4.5	1.0
MON-18	-2400.0	-2320.0	6990.3	4.5	1.5	1.0
MON-19	-2600.0	-1555.0	6993.8	3.5	1.0	0.5
MON-20	-2369.0	-1600.0	6985.1	2.5	0.5	0
MON-21	-2400.0	-1700.0	6981.0	3.3	2.0	1.0
MON-22	-2586.0	-1135.0	6978.1	3.8	1.0	1.0
MON-23	-2104.0	-1600.0	6958.3	3.3	2.0	1.5
MON-24	-1800.0	-1400.0	6942.0	3.0	1.5	1.0
MON-25	-2000.0	-1969.0	6933.4	3.3	2.5	0.5
MON-26	-2040.0	-2000.0	6936.8	7.0	>7.0	7.0
MON-27	-2000.0	-1969.0	6933.4	4.3	0.5	0
MON-28	-2000.0	-2000.0	6937.0	2.8	0	0
MON-29	-2583.0	-2000.0	6979.9	3.7	1.0	1.0
MON-30	-2630.0	-1970.0	6982.0	3.0	1.0	0.5
MON-31	-1550.0	-2200.0	6924.4	4.3	1.0	0.5
MON-32	-1529.0	-2400.0	6933.8	4.5	1.0	0
MON-33	-2160.0	-2600.0	6959.2	3.0	1.0	0.5

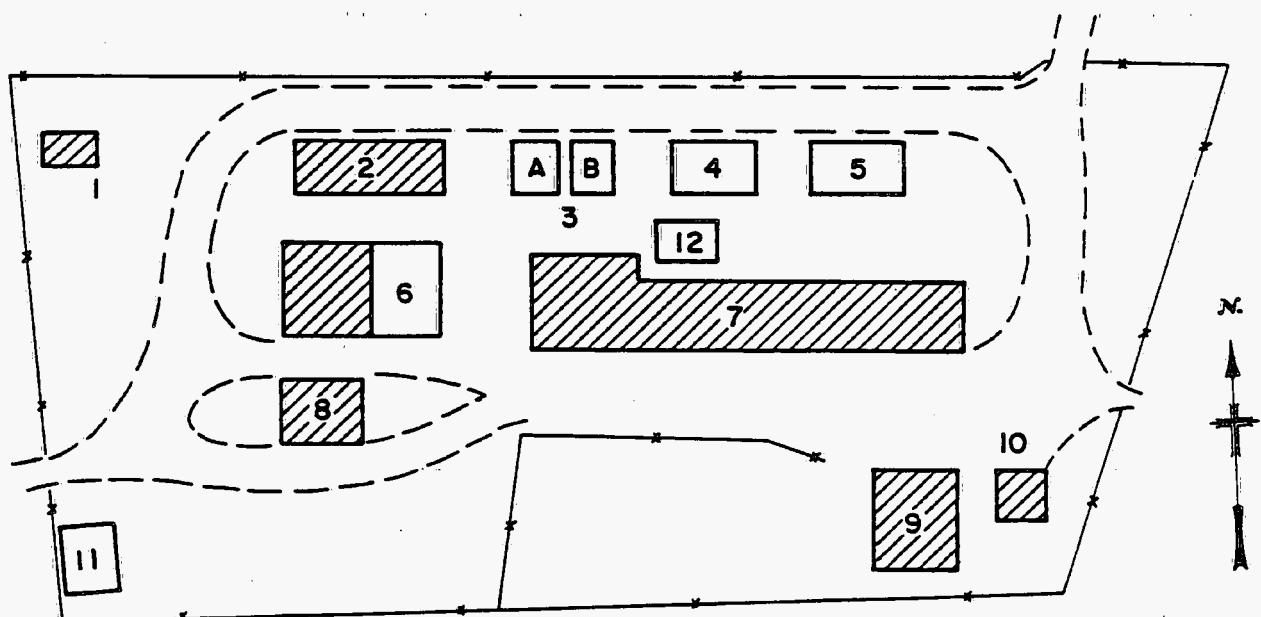
Table H-1 (continued)

Hole No.	Grid Coordinates		Elevation (ft)	Log Depth (ft)	Maximum Depth of Ra-226 Contamination (ft):	
	North	East			>6 pCi/g	>16 pCi/g
MON-34	-1249.0	-2559.0	6902.9	4.8	2.5	0.5
MON-35	-1238.0	-2599.0	6901.8	2.0	1.5	0.5
MON-36	-925.0	-2015.0	6876.7	1.7	0.5	0.5
MON-37	-850.0	-2200.0	6879.2	1.6	>1.6	>1.6
MON-38	-1213.3	-3194.0	6883.8	6.0	>6.0	>6.0
MON-39	-1213.0	-3176.0	6884.4	5.6	>5.6	>5.6
MON-40	-1109.0	-3331.0	6890.2	1.5	>1.5	>1.5
MON-41	-1021.6	-3400.0	6892.3	4.3	2.5	2.0
MON-42	-1009.0	-2992.0	6877.0	4.6	1.0	1.0
MON-44	-810.0	-3065.0	-99.0	4.8	2.0	1.0
MON-45	-604.3	-2799.9	6877.2	4.0	1.5	1.0
MON-46	-600.0	-2660.0	6870.6	4.9	3.0	2.5
MON-47	-801.6	-2805.5	6871.0	4.9	1.0	1.0
MON-48	-798.0	-2602.0	6868.1	3.7	>3.7	>3.7
MON-49	-925.0	-1800.0	6875.9	4.9	3.0	1.5
MON-50	-652.0	-3818.0	6962.5	2.3	>2.3	>2.3
MON-51	-456.0	-4019.0	6980.6	2.3	1.5	1.0
MON-52	-455.0	-3993.0	6985.4	1.8	0.5	0
MON-53	-627.0	-3418.0	6959.5	2.3	>2.3	>2.3
MON-54	-219.0	-3247.0	6977.3	1.8	1.0	1.0
MON-55	-231.0	-3497.0	6984.8	4.5	1.5	1.0
MON-56	-246.0	-3863.0	6991.9	2.4	1.0	1.0
MON-57	-47.0	-3857.0	6997.6	2.5	1.0	0.5
MON-58	-1190.0	730.0	6794.0	3.0	2.0	1.0
MON-59	-1200.0	820.0	6792.9	3.4	1.0	0.5
MON-60	-1200.0	898.0	6791.7	2.1	>2.1	>2.1
MON-61	-1275.0	1025.0	6790.0	5.3	5.3	2.5
MON-62	-1295.0	1200.0	6785.3	5.0	2.0	1.5
MON-63	-1600.0	749.0	6814.0	5.0	1.0	1.0
MON-64	-800.0	200.0	6805.1	2.8	0.5	0
MON-65	-1000.0	200.0	6803.5	2.5	>2.5	>2.5
MON-66	-1000.0	600.0	6796.4	5.8	1.0	0
MON-67	-1016.0	680.0	6794.8	5.8	5.0	3.0
MON-68	-1120.0	790.0	6793.2	5.3	3.5	2.0
MON-69	-1200.0	1200.0	6785.6	7.6	4.5	1.0
MON-70	-1320.0	1575.0	6780.2	4.4	>4.4	>4.4
MON-71	-1536.0	1600.0	6778.8	4.7	>4.7	2.5
MON-43	NORTH BACKGROUND			1.8		
MON-100	SOUTH BACKGROUND			2.2		
MON-101	EAST BACKGROUND			1.1		

Appendix I

BUILDING RADIOMETRIC-SURVEY RESULTS

Seven buildings and seven concrete foundations within the BLM compound at the Monticello millsite were surveyed for alpha contamination, gamma-ray exposure rate, and in-situ radium concentration. Locations of the buildings and foundations are shown in Figure I-1; survey results are presented in Figures I-2 through I-38.



EXPLANATION

- Building
- Foundation or Slab

**Figure I-1. Map of ELM Compound on the Monticello Millsite
Showing Building and Foundation Locations**

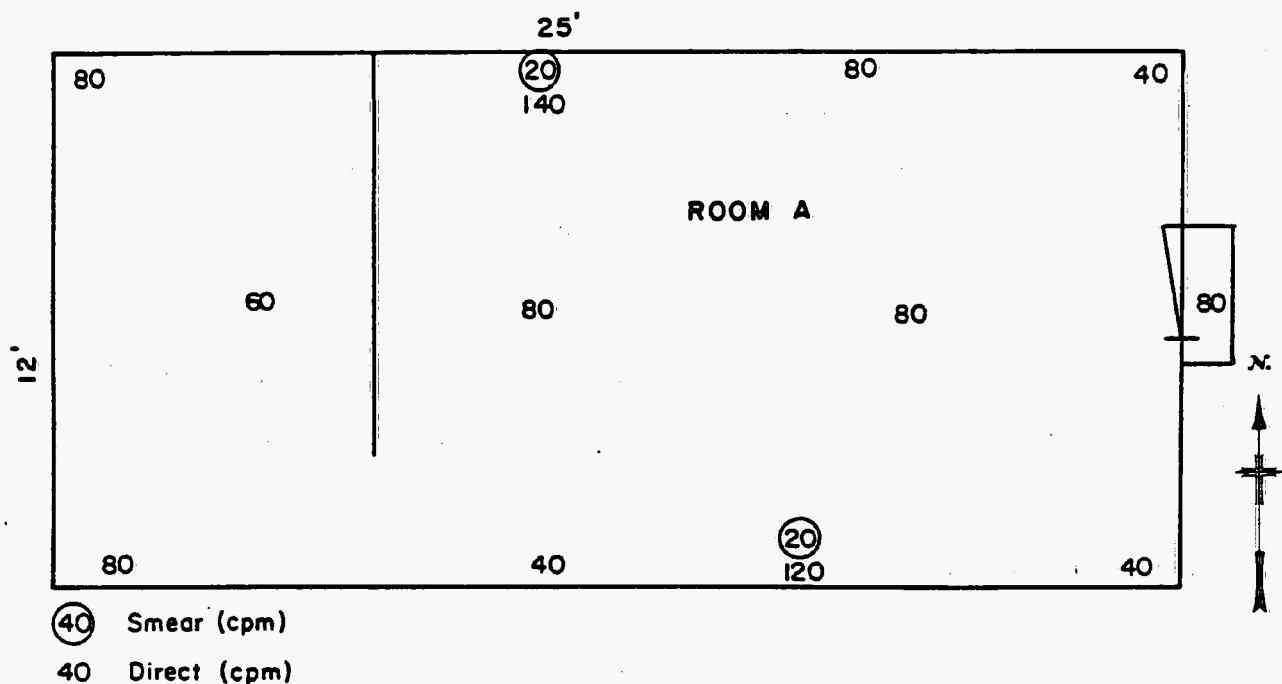
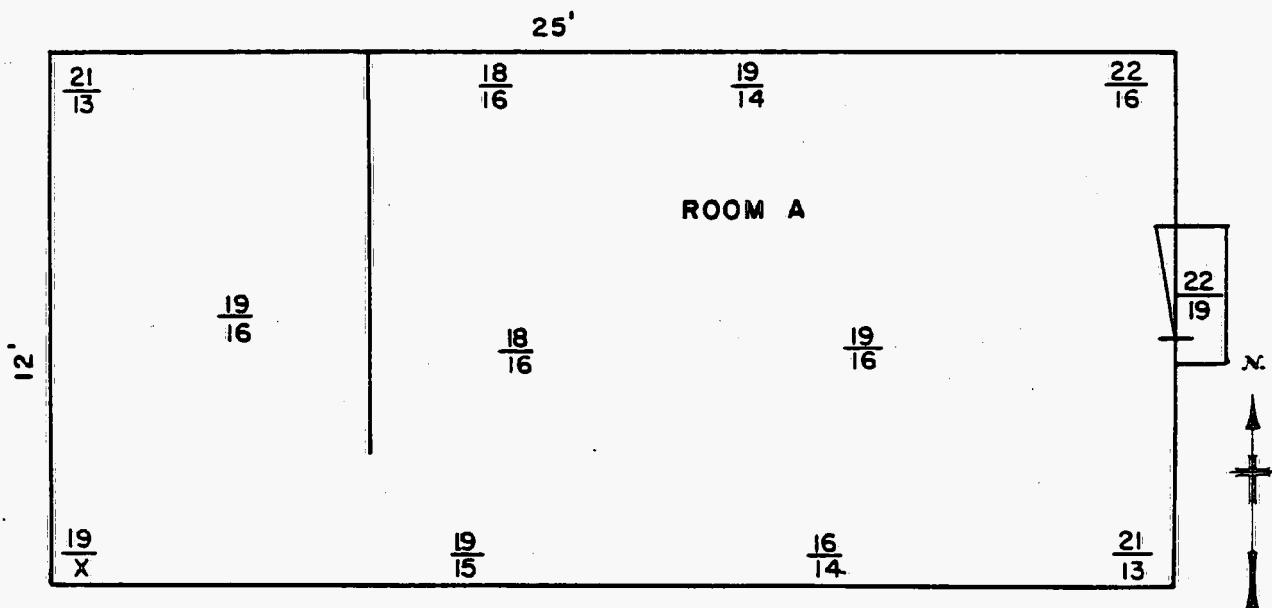
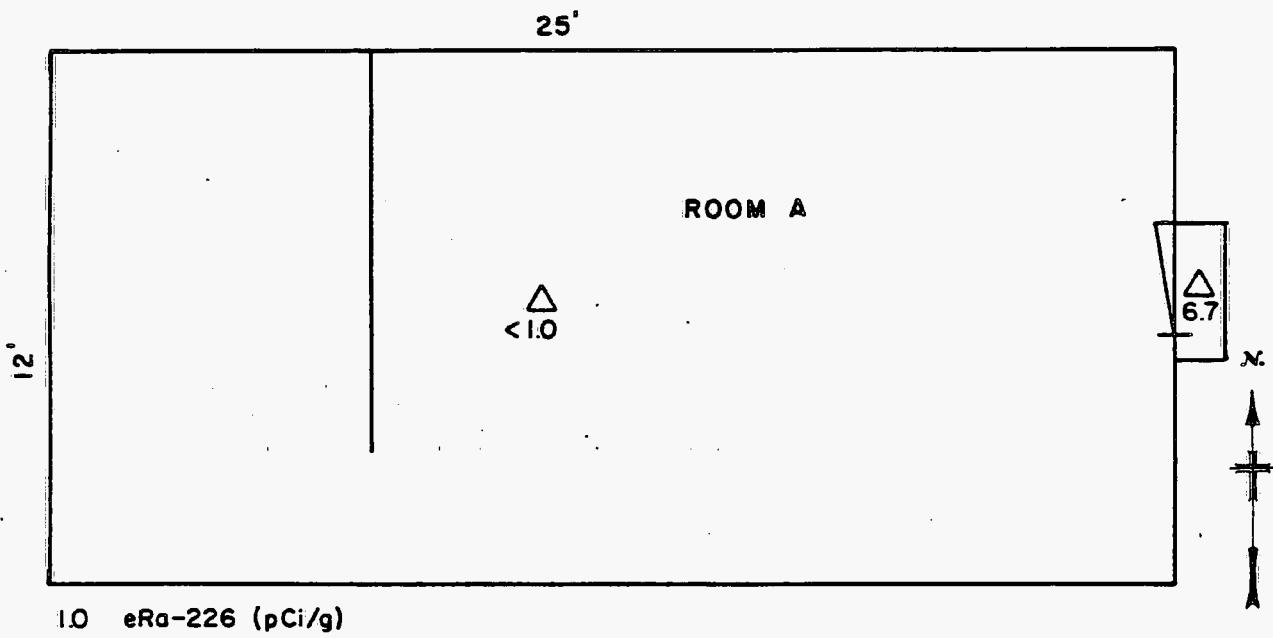


Figure I-2. Building 1: Alpha Measurement Results



$\frac{18}{18}$ Waist Level ($\mu\text{R}/\text{h}$)
 $\frac{18}{18}$ Surface ($\mu\text{R}/\text{h}$)
 X No Reading

Figure I-3. Building 1: Exposure-Rate Measurement Results



1.0 eRa-226 (pCi/g)

Figure I-4. Building 1: Delta-Gamma Measurement Results

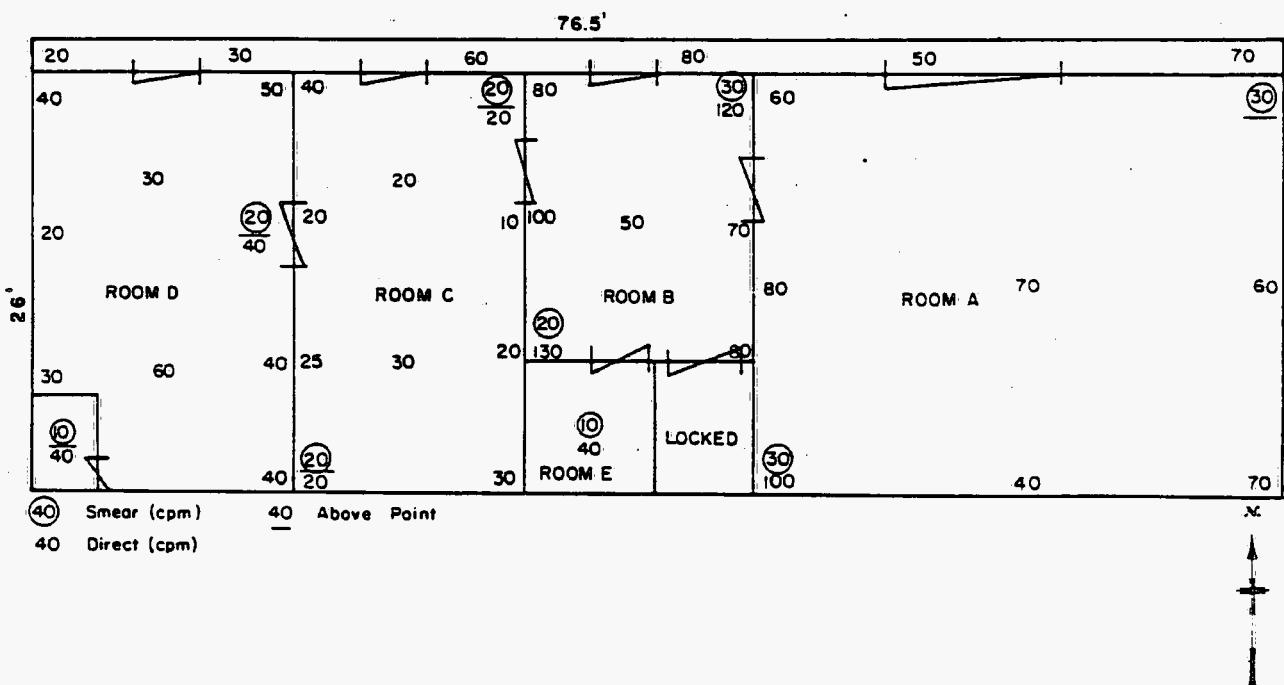


Figure I-5. Building 2: Alpha Measurement Results

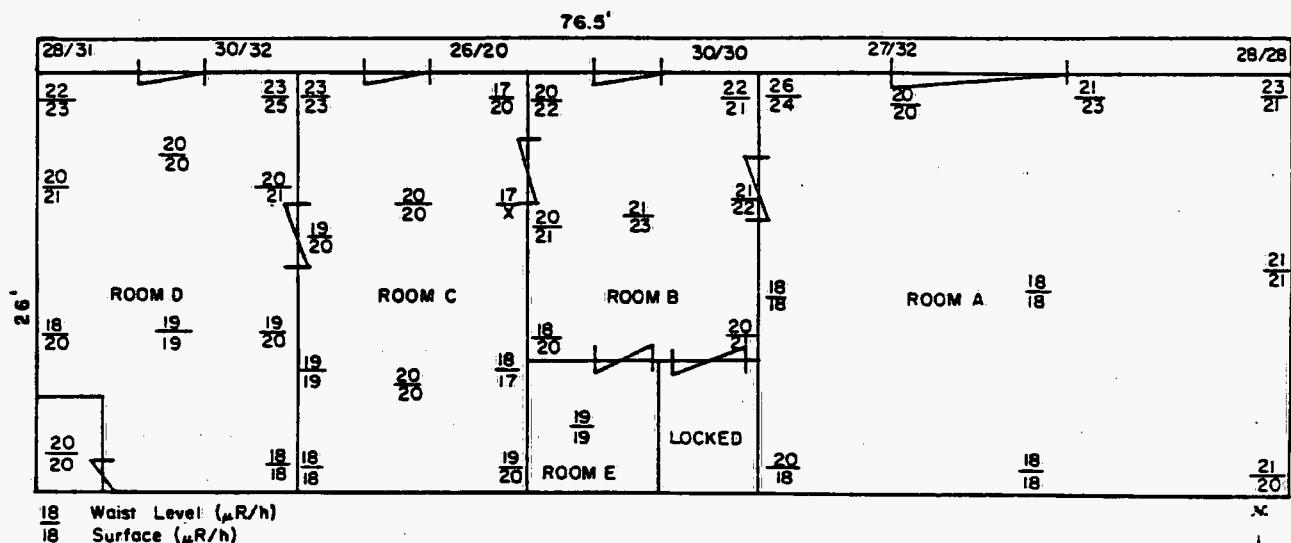


Figure I-6. Building 2: Exposure-Rate Measurement Results

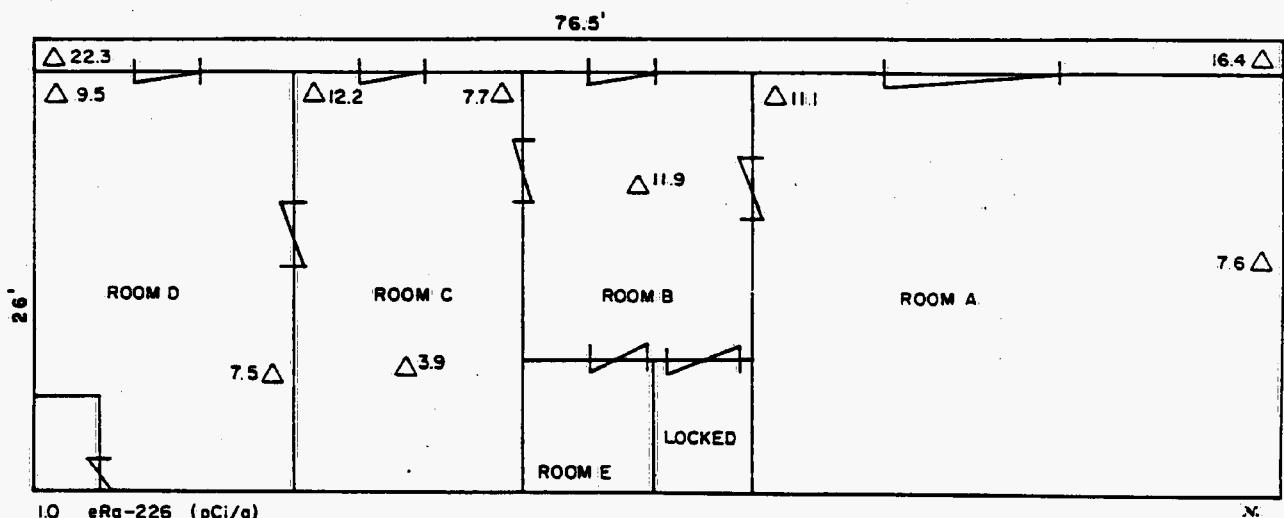


Figure I-7. Building 2: Delta-Gamma Measurement Results

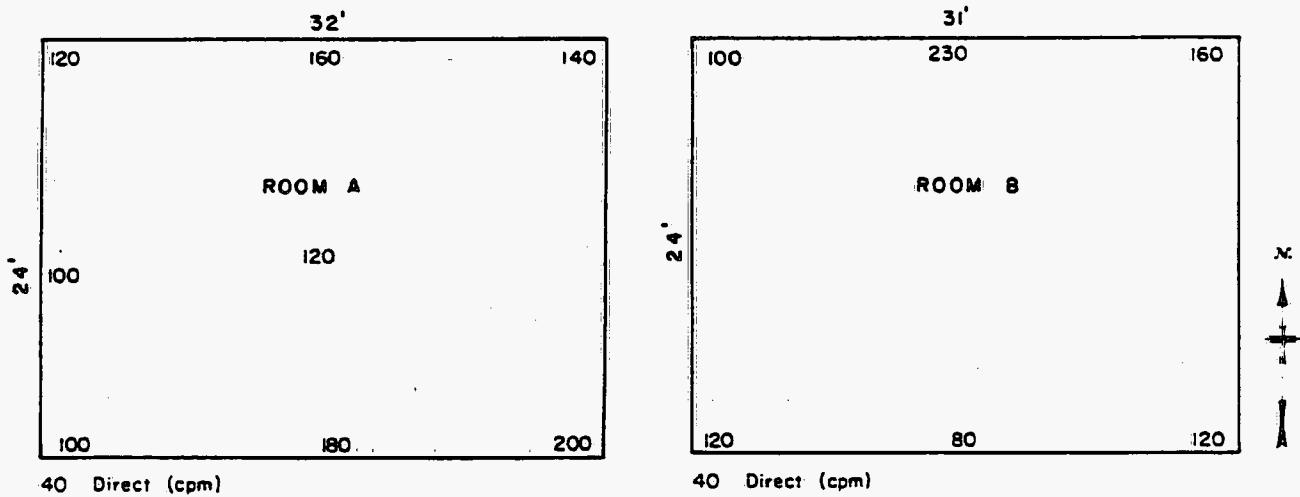


Figure I-8. Building 3 Foundation: Alpha Measurement Results

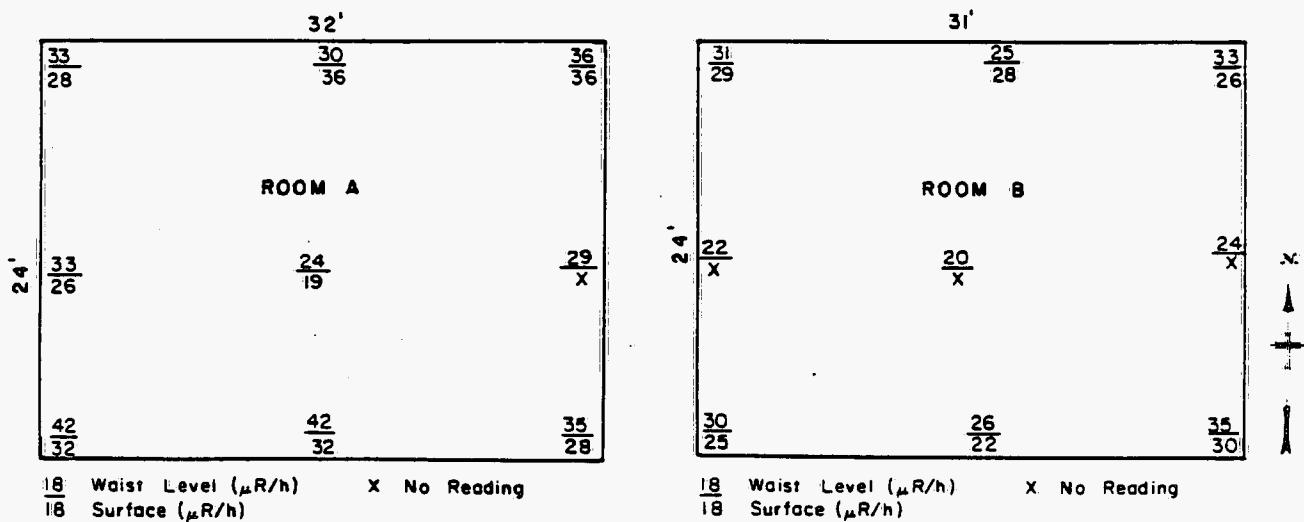


Figure I-9. Building 3 Foundation: Exposure-Rate Measurement Results

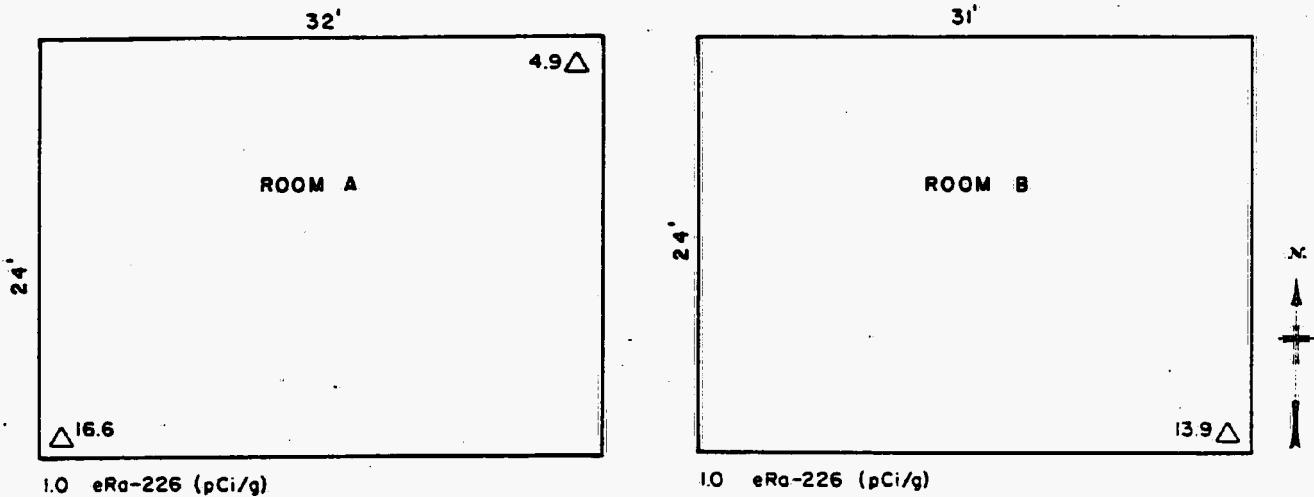


Figure I-10. Building 3 Foundation: Delta-Gamma Measurement Results

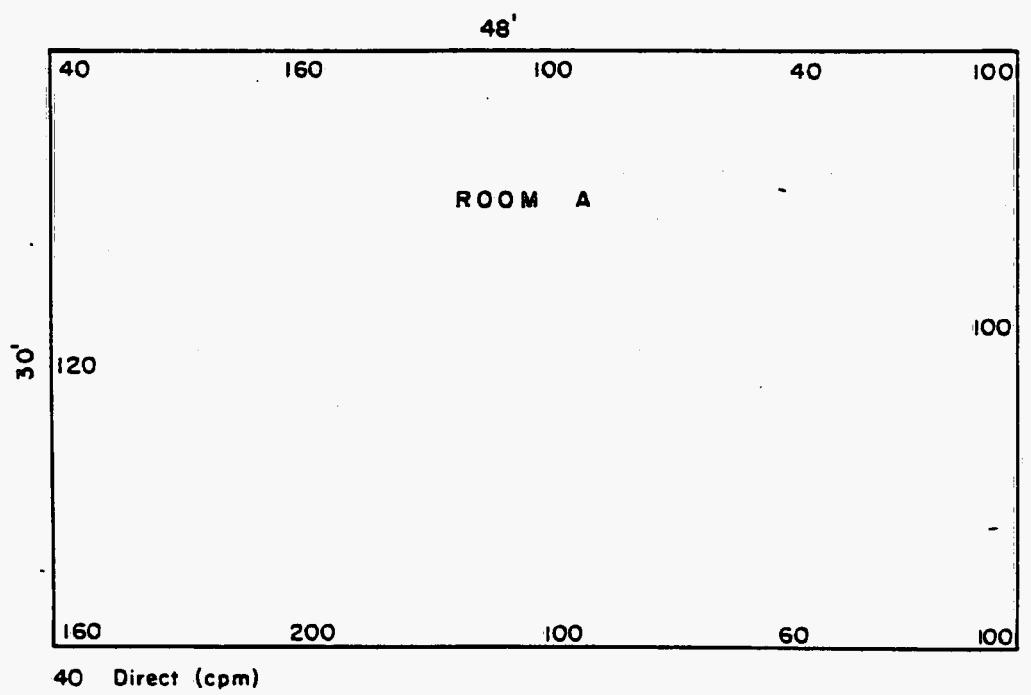


Figure I-11. Building 4 Foundation: Alpha Measurement Results

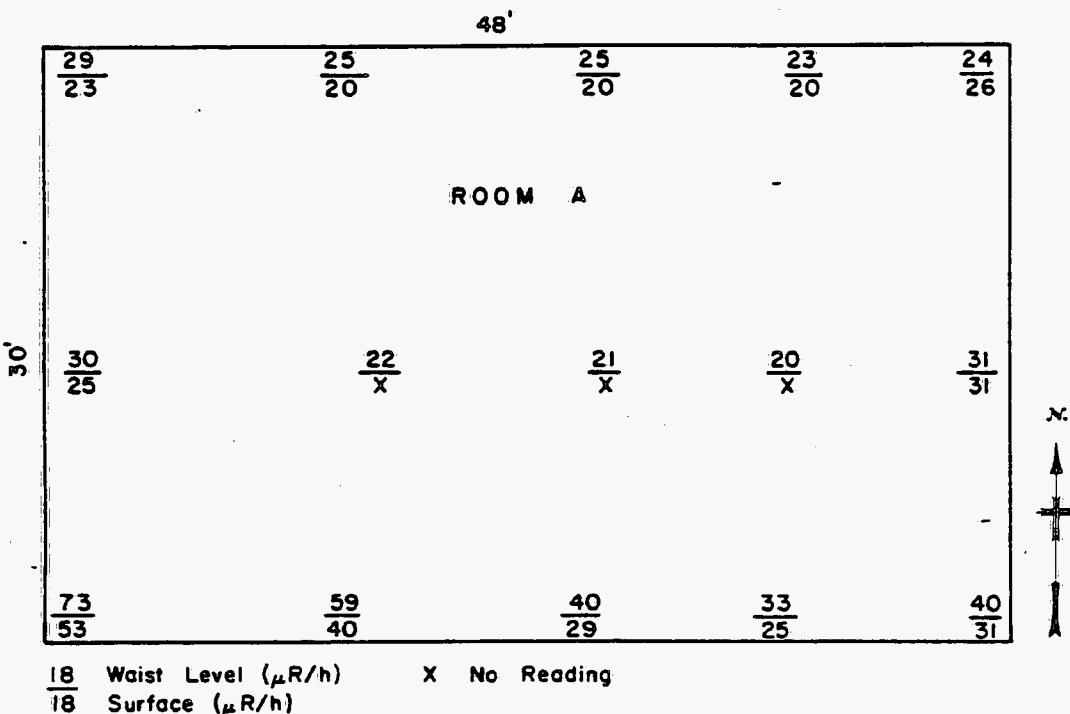


Figure I-12. Building 4 Foundation: Exposure-Rate Measurement Results

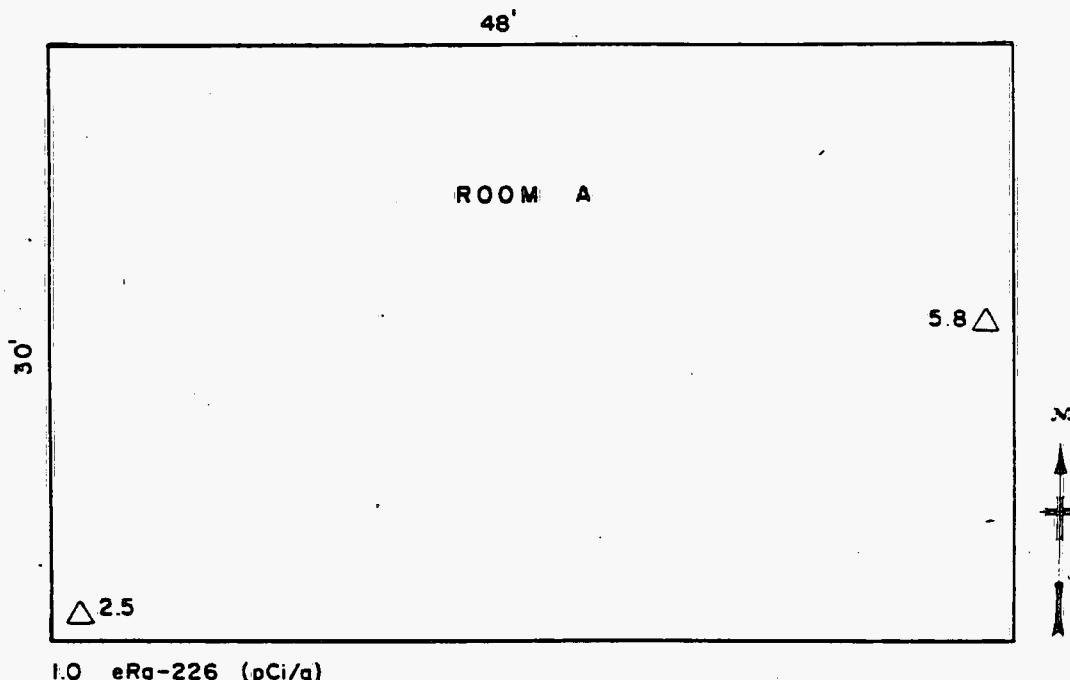


Figure I-13. Building 4 Foundation: Delta-Gamma Measurement Results

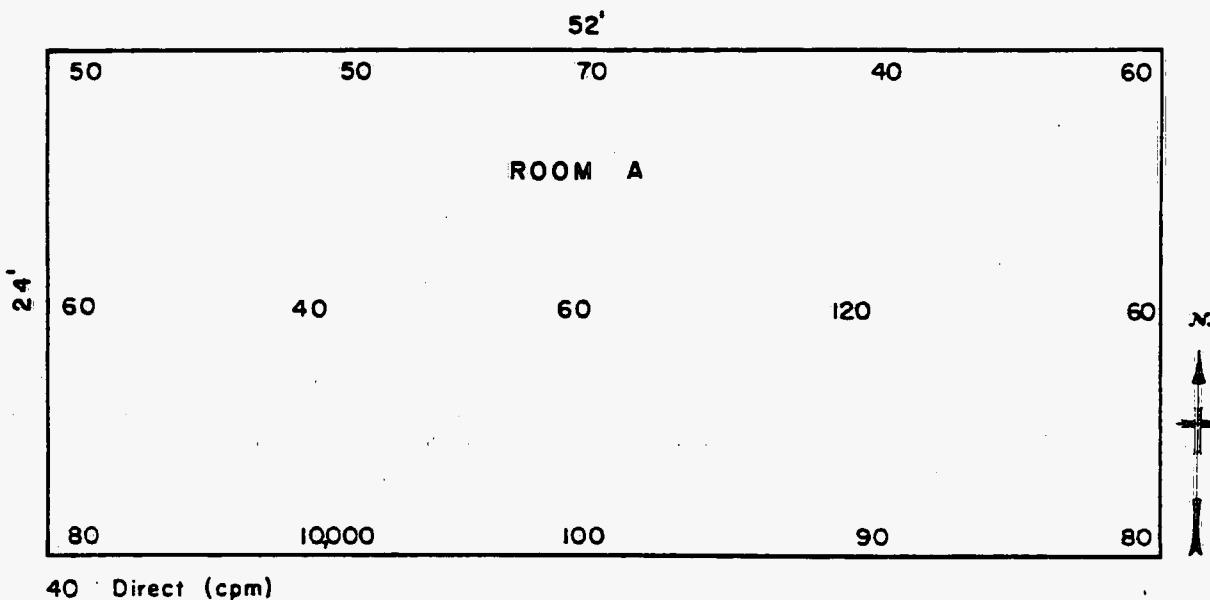
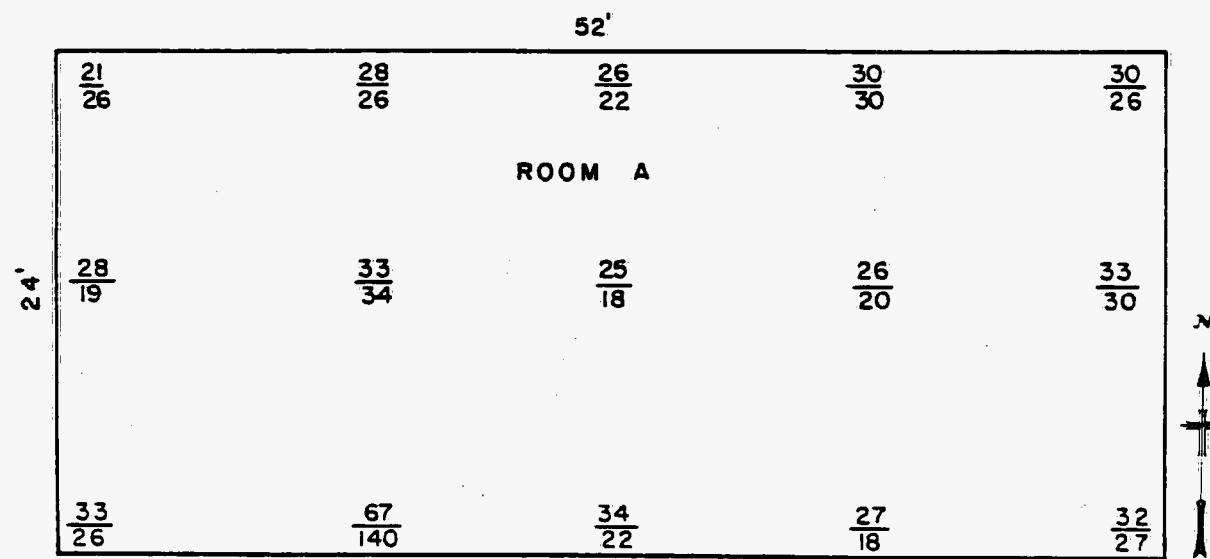
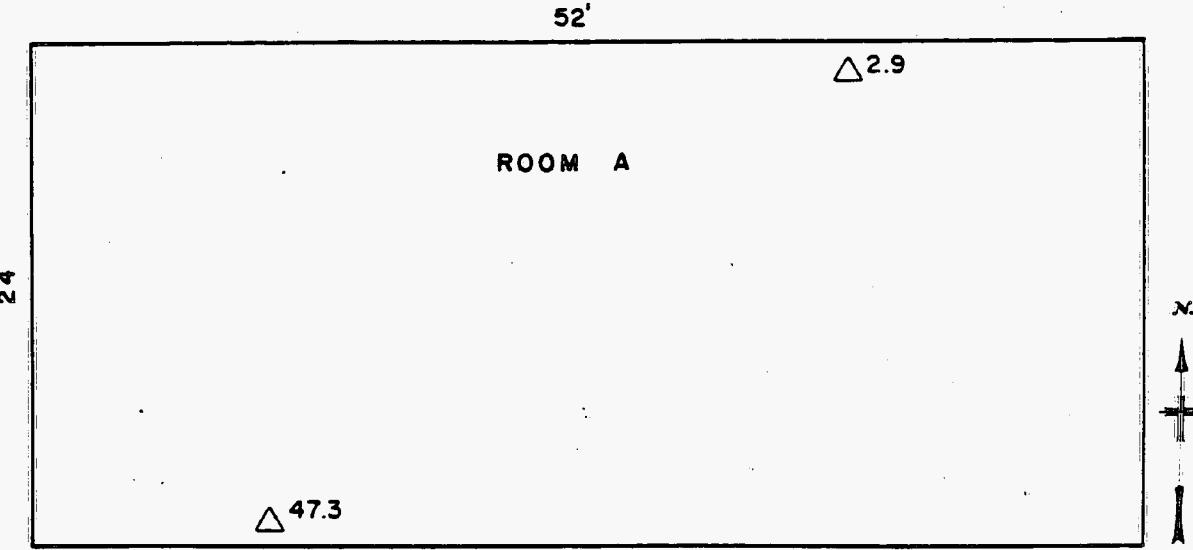


Figure I-14. Building 5 Foundation: Alpha Measurement Results



18 Waist Level (μ R/h)
 18 Surface (μ R/h)

Figure I-15. Building 5 Foundation: Exposure-Rate Measurement Results



1.0 eRa-226 (pCi/g)

Figure I-16. Building 5 Foundation: Delta-Gamma Measurement Results

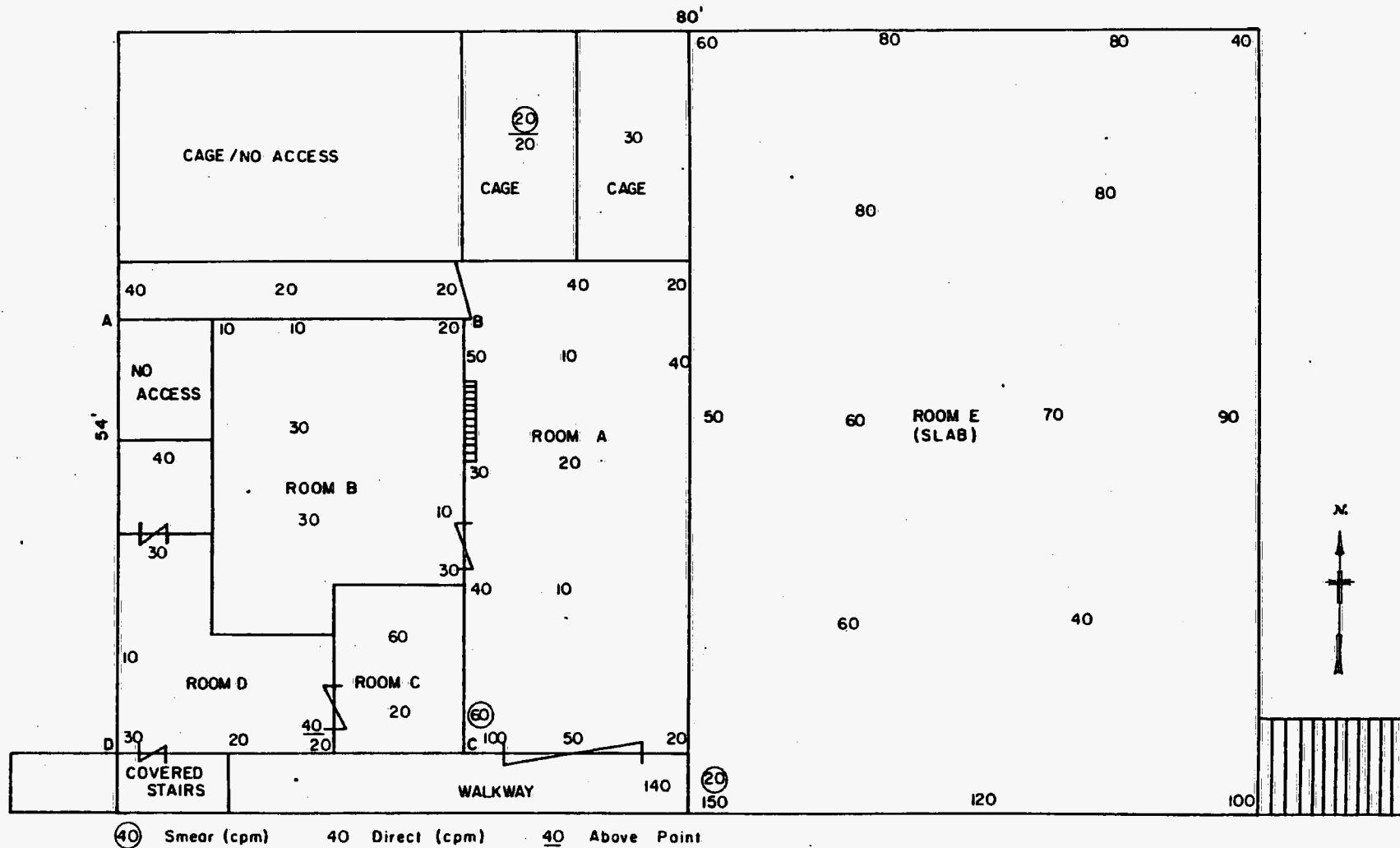


Figure I-17. Building 6: Alpha Measurement Results

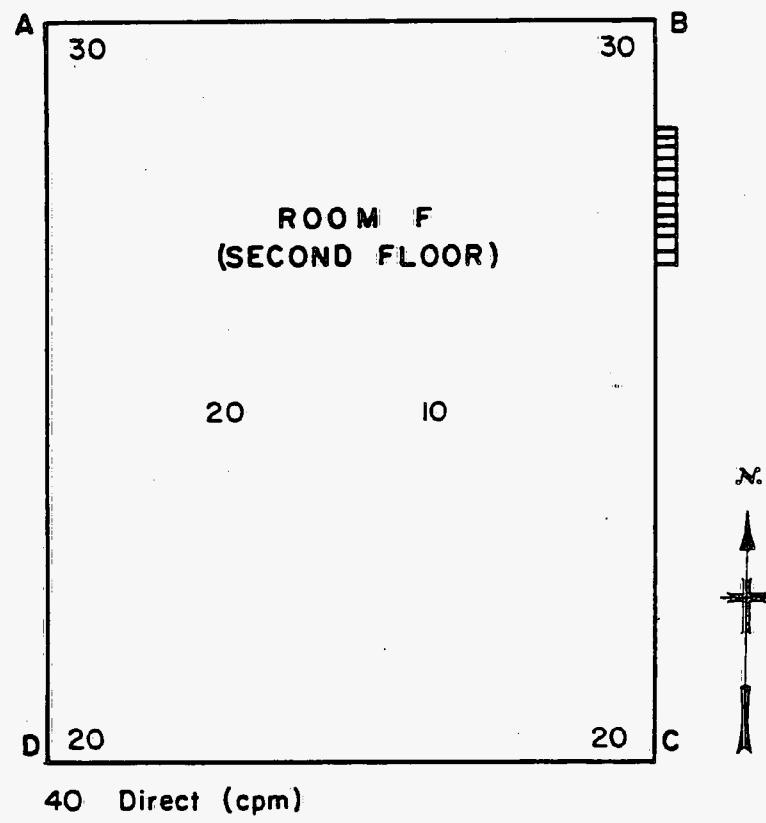


Figure I-18. Building 6, Second Floor: Alpha Measurement Results

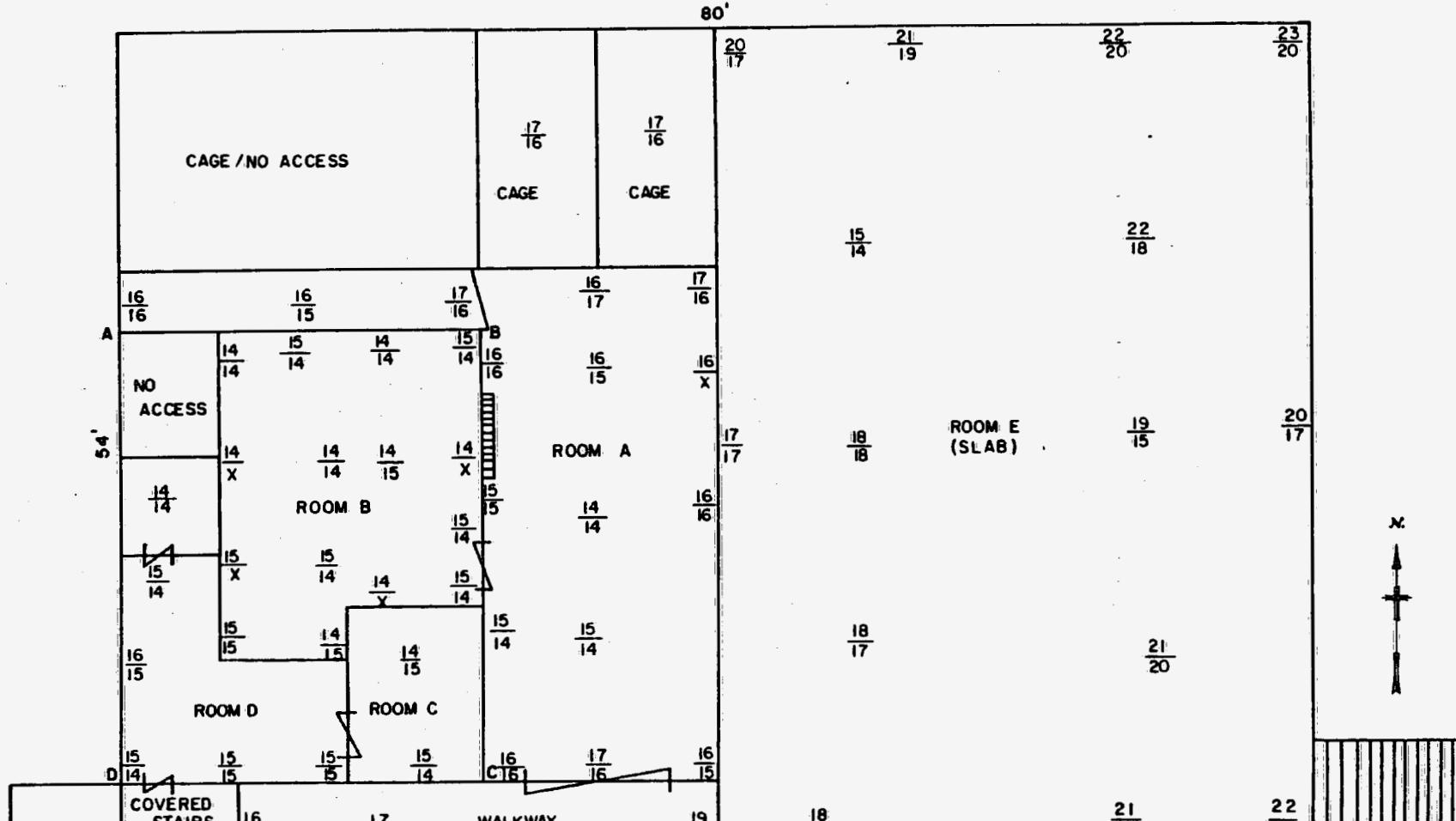


Figure I-19. Building 6: Exposure-Rate Measurement Results

I-14

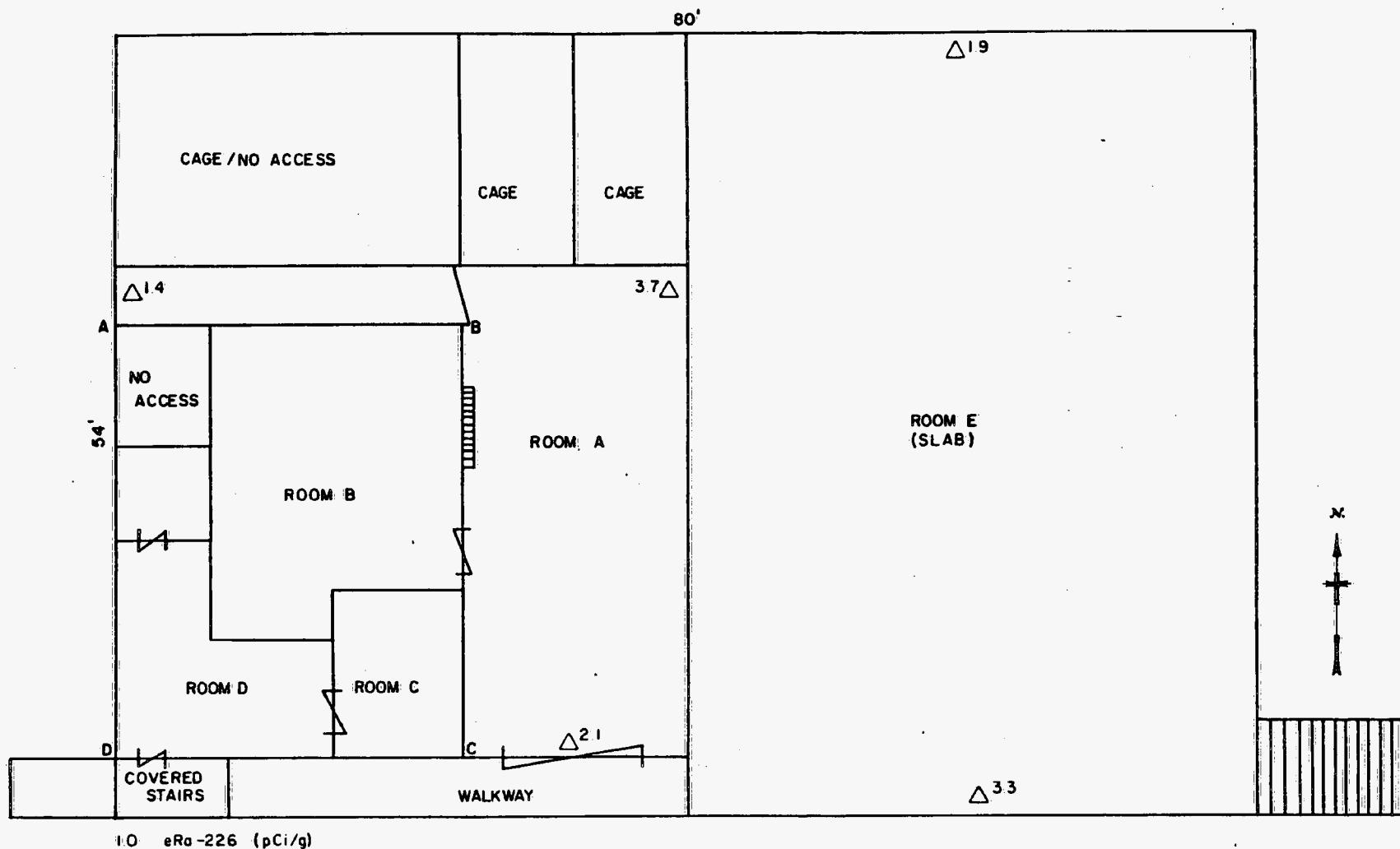


Figure I-20. Building 6: Delta-Gamma Measurement Results

H-15

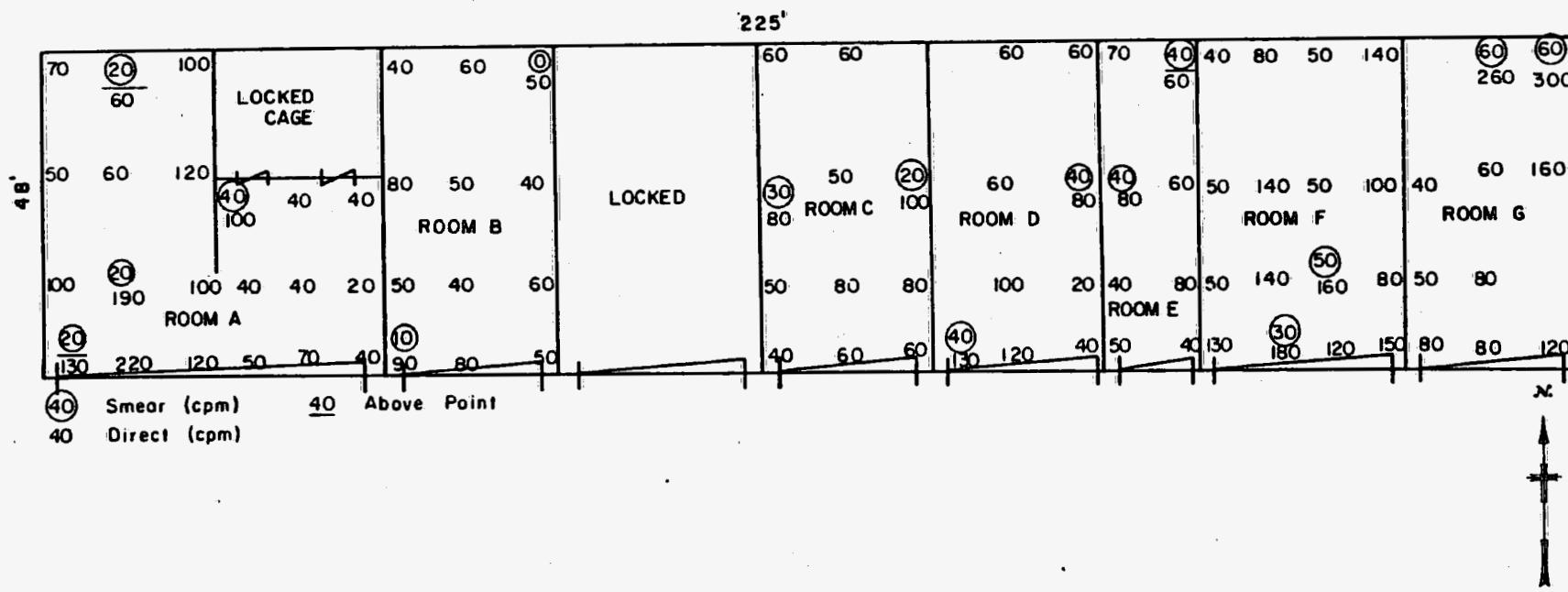


Figure I-21. Building 7: Alpha Measurement Results

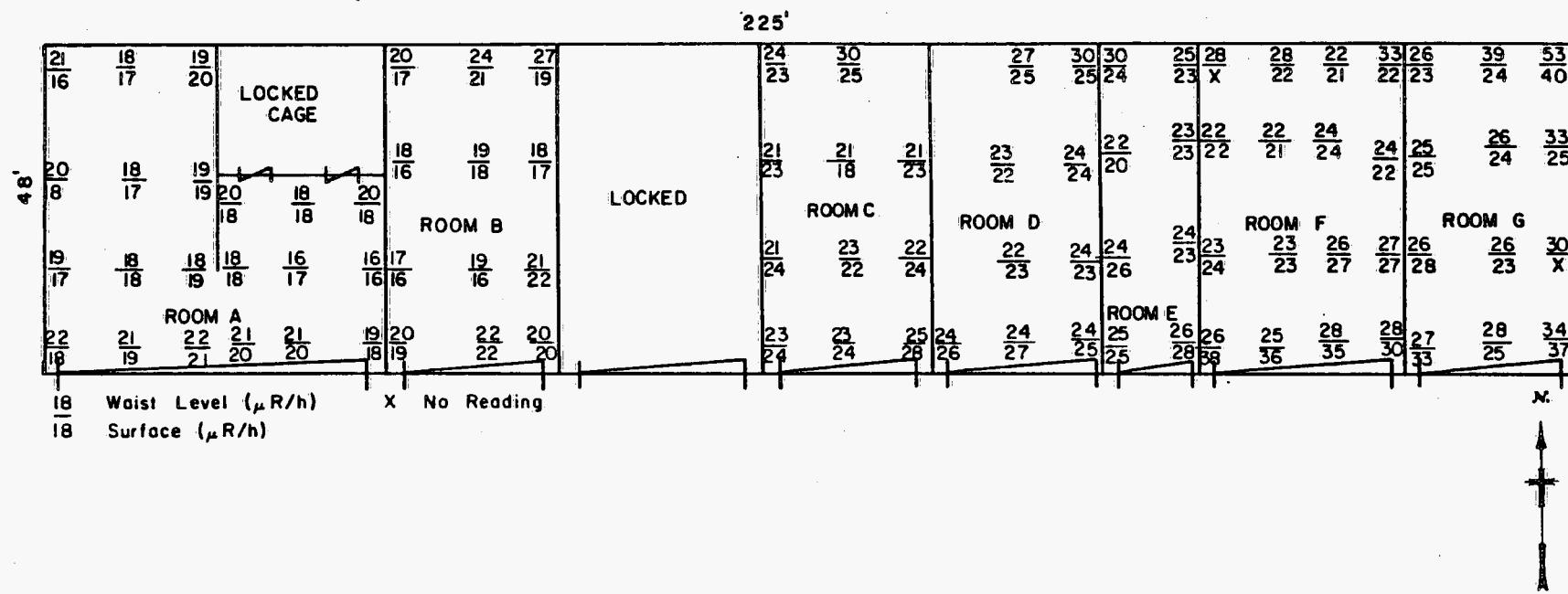


Figure I-22. Building 7: Exposure-Rate Measurement Results

I-17

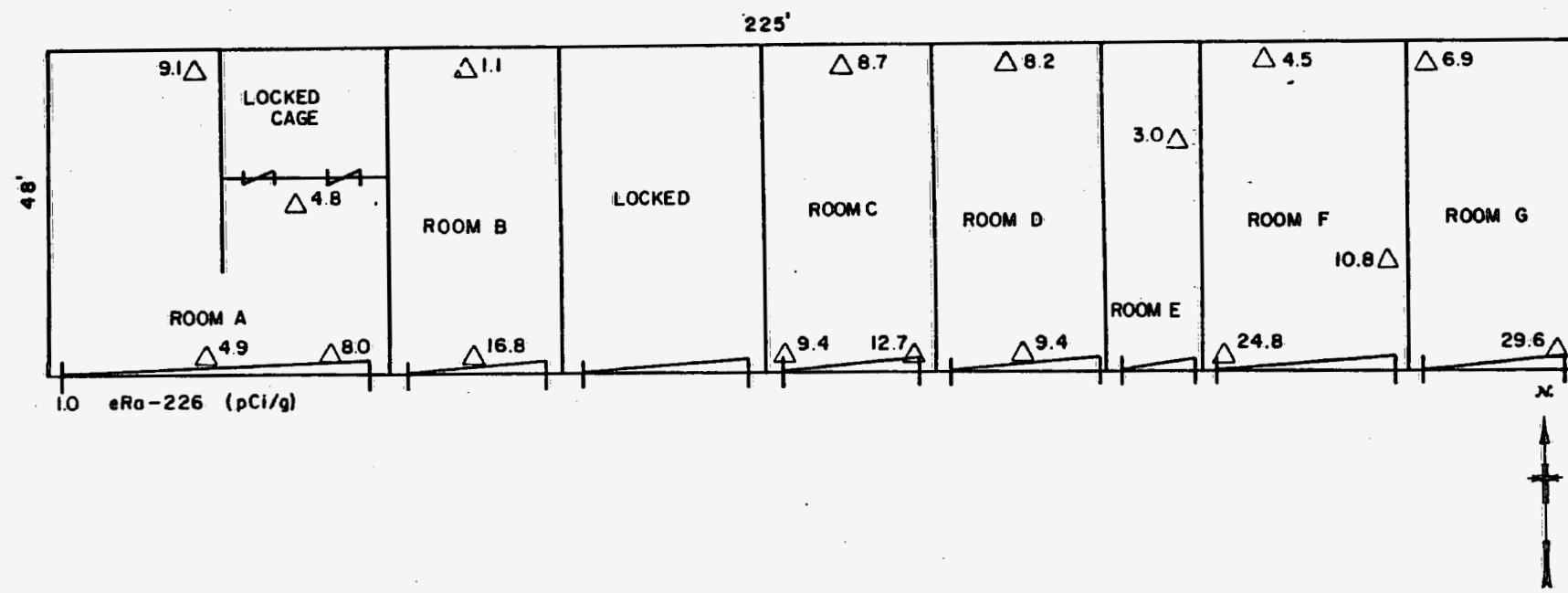


Figure I-23. Building 7: Delta-Gamma Measurement Results

I-18

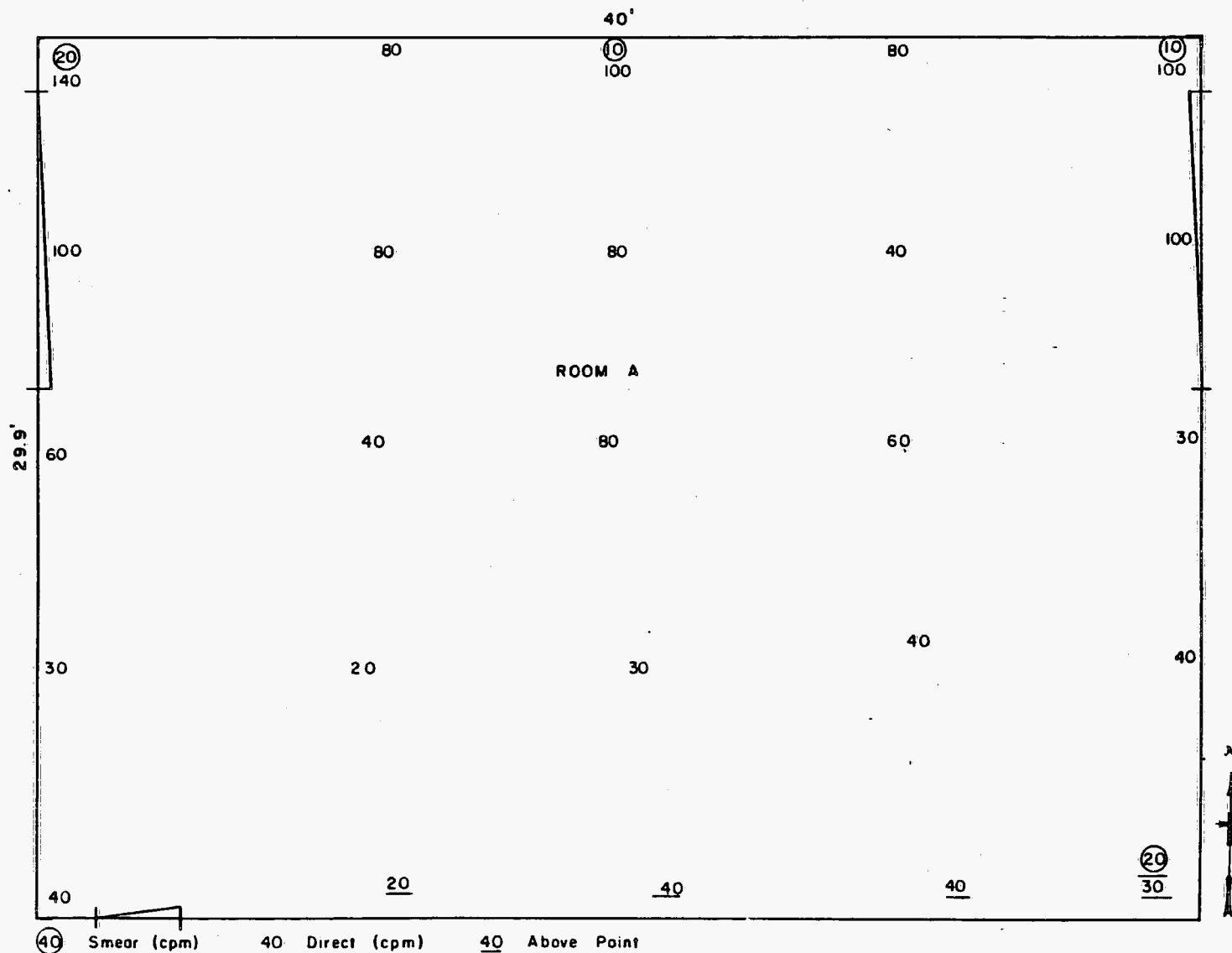


Figure I-24. Building 8: Alpha Measurement Results

I-19

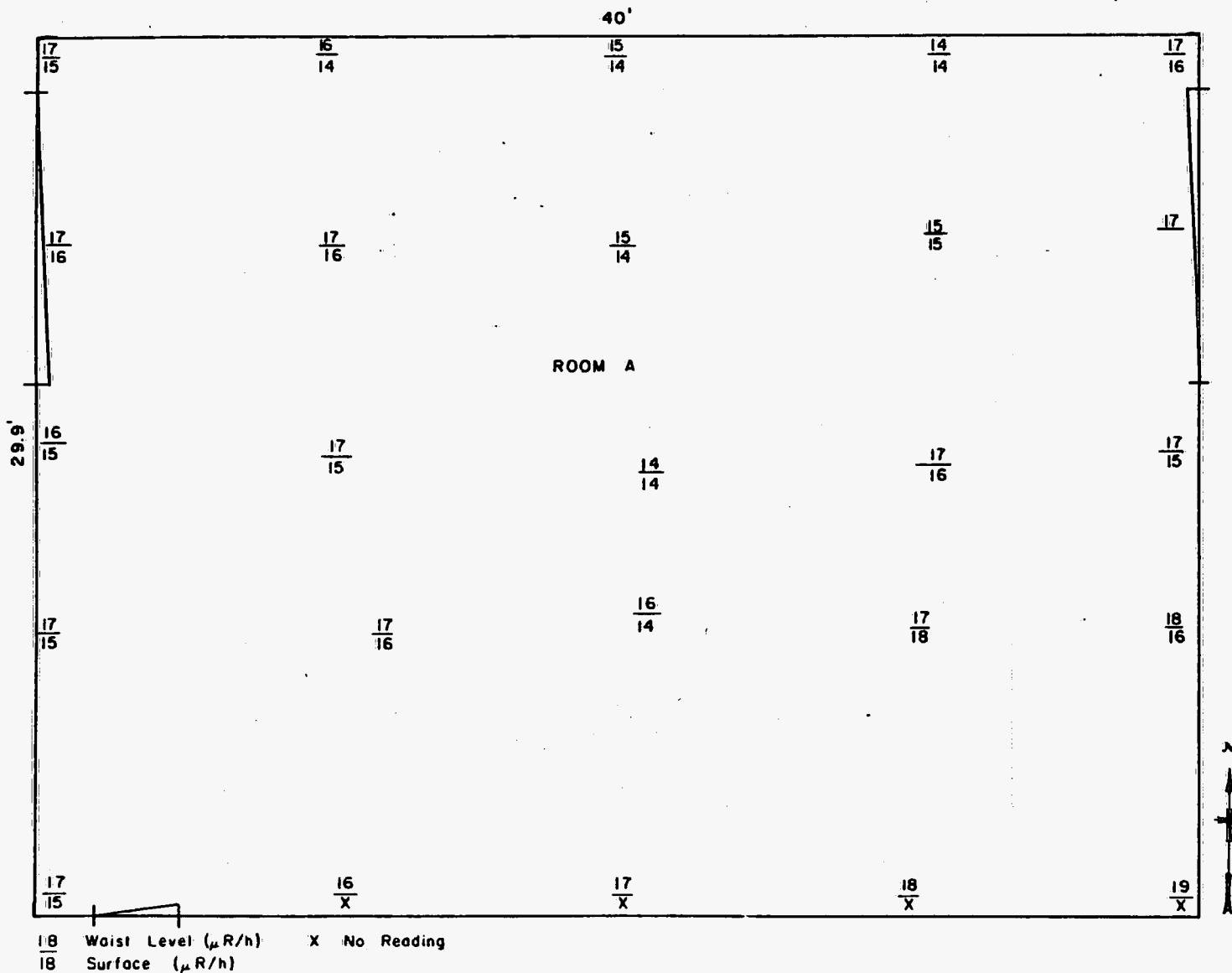


Figure I-25. Building 8: Exposure-Rate Measurement Results

I-20

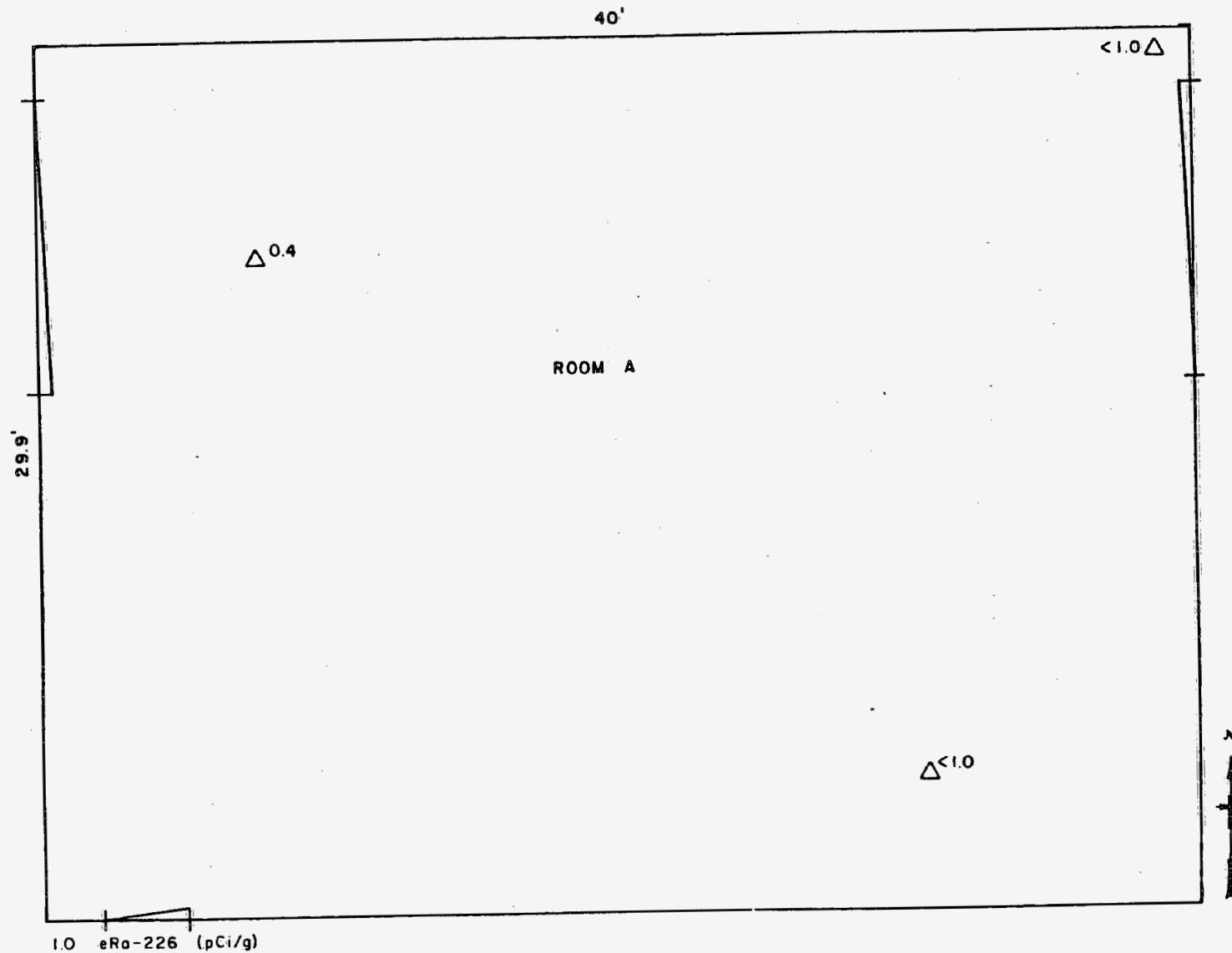


Figure I-26. Building 8: Delta-Gamma Measurement Results

I-21

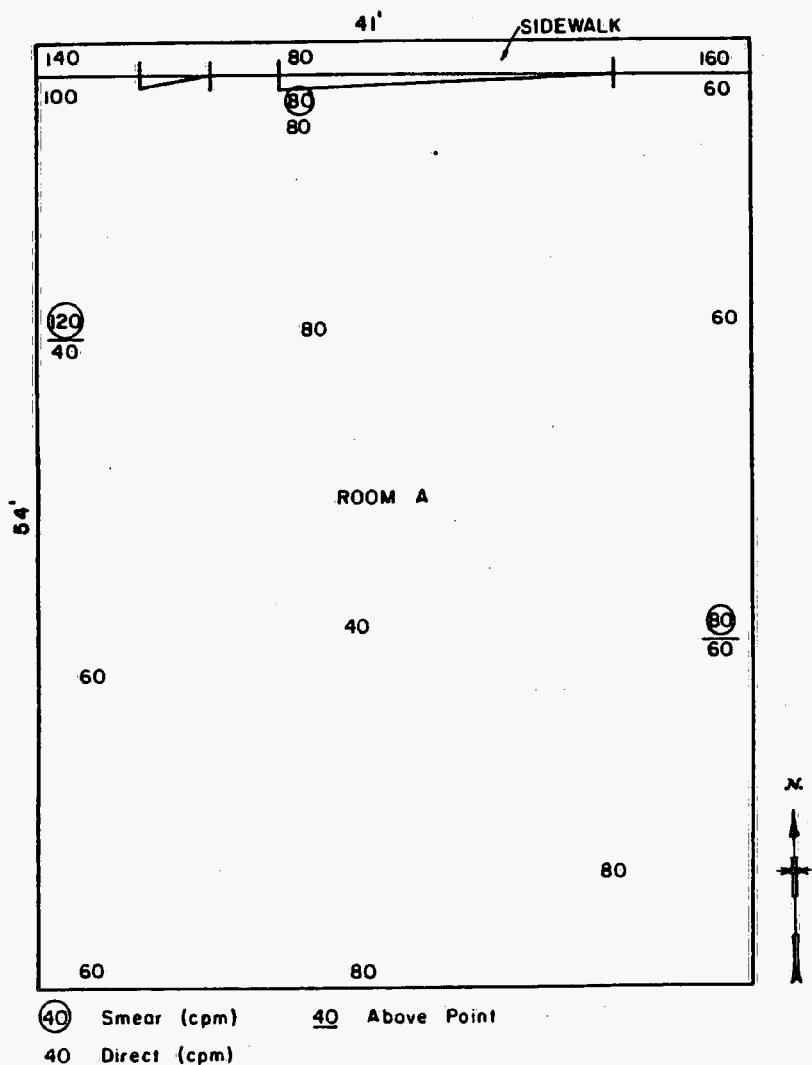


Figure I-27. Building 9: Alpha Measurement Results

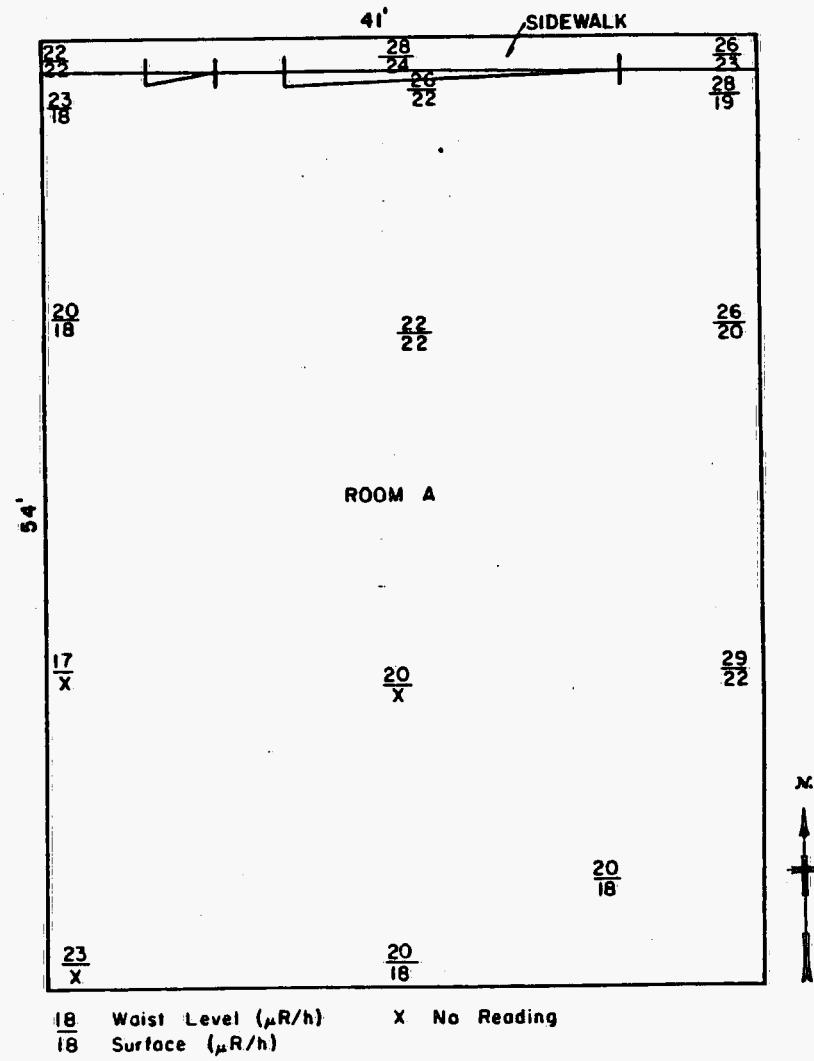


Figure I-28. Building 9: Exposure-Rate Measurement Results

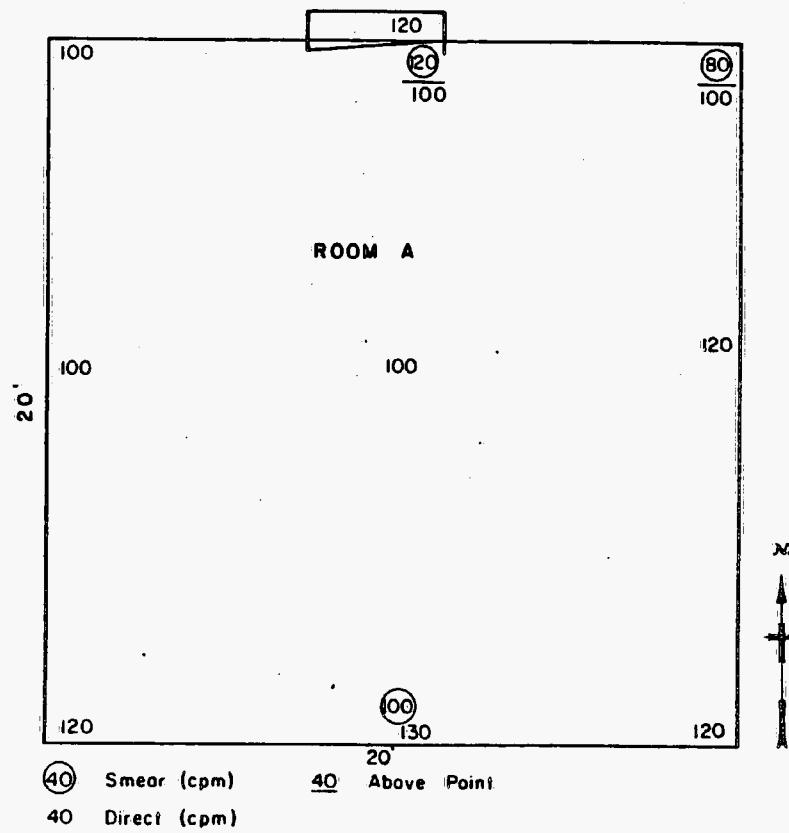
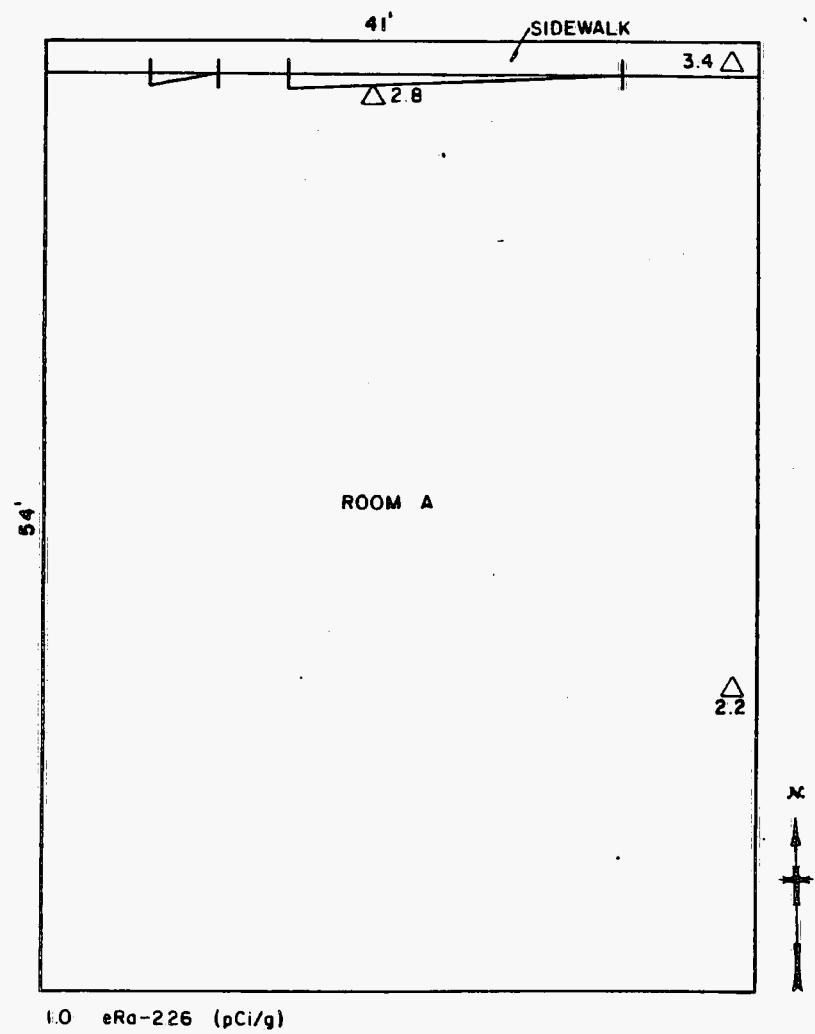
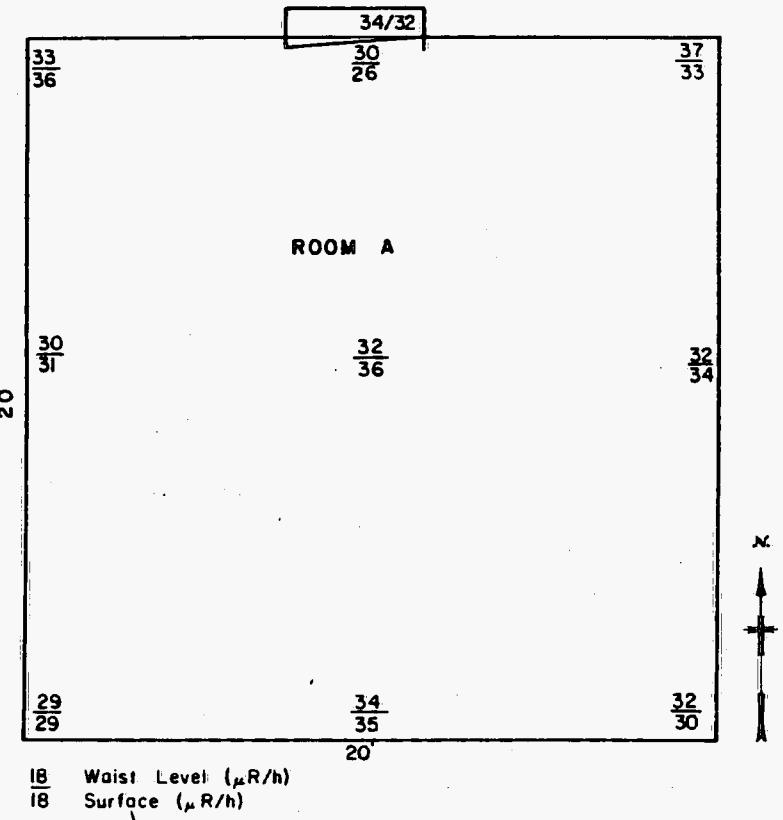


Figure I-29. Building 9: Delta-Gamma Measurement Results

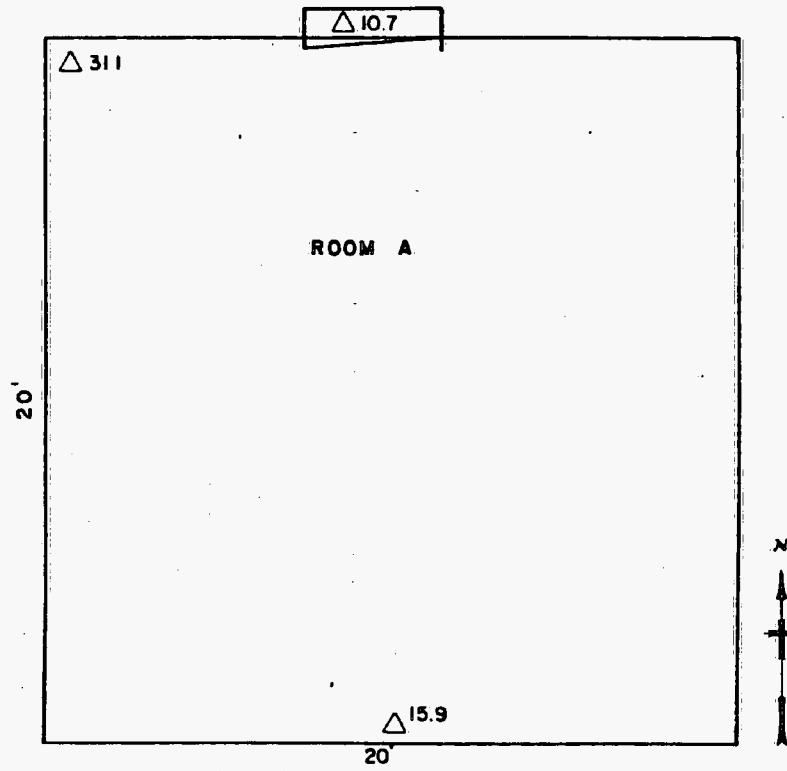
Figure I-30. Building 10: Alpha Measurement Results

I-23



18 Waist Level ($\mu\text{R}/\text{h}$)
18 Surface ($\mu\text{R}/\text{h}$)

Figure I-31. Building 10: Exposure-Rate Measurement Results



10 $\text{eRa-226} (\text{pCi/g})$

Figure I-32. Building 10: Delta-Gamma Measurement Results

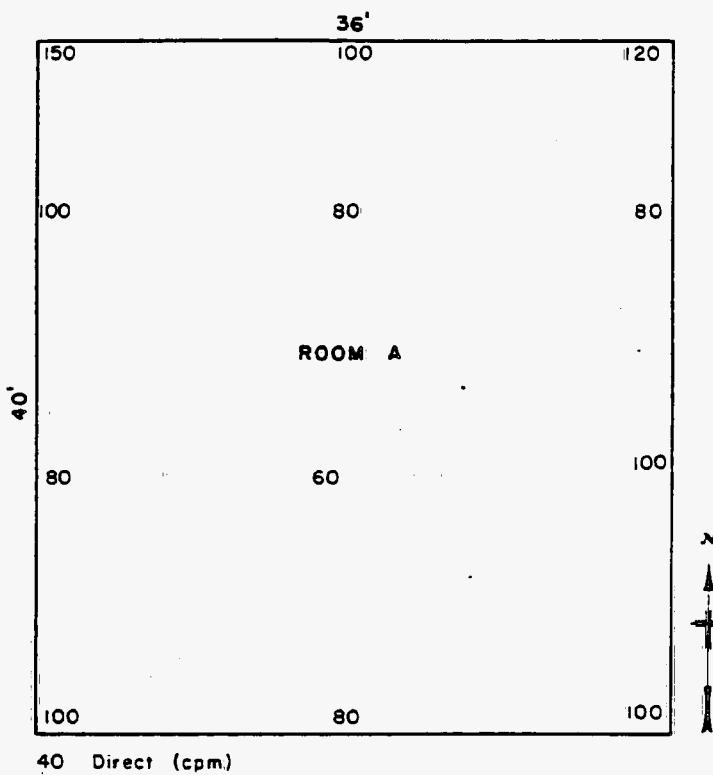


Figure I-33. Building 11 Foundation: Alpha Measurement Results

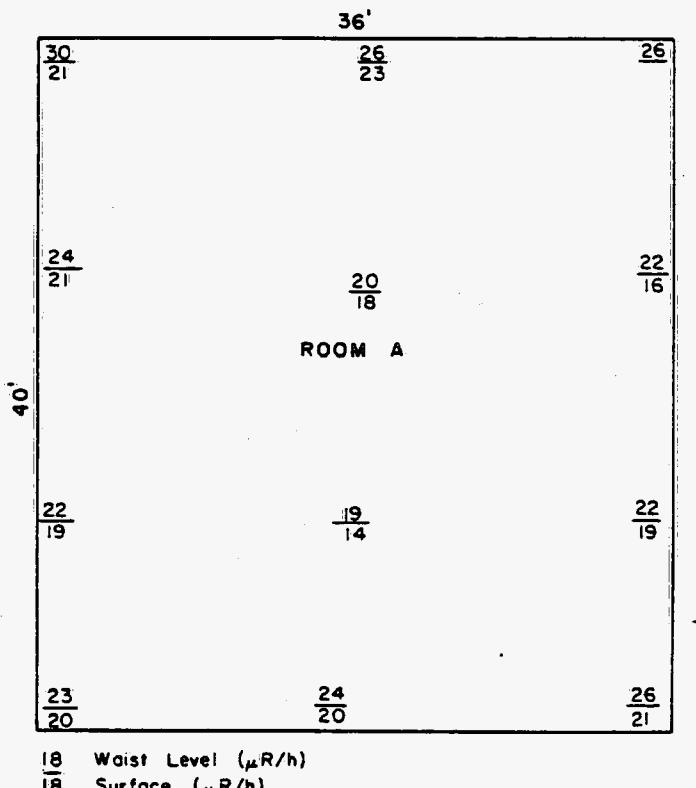


Figure I-34. Building 11 Foundation: Exposure-Rate Measurement Results

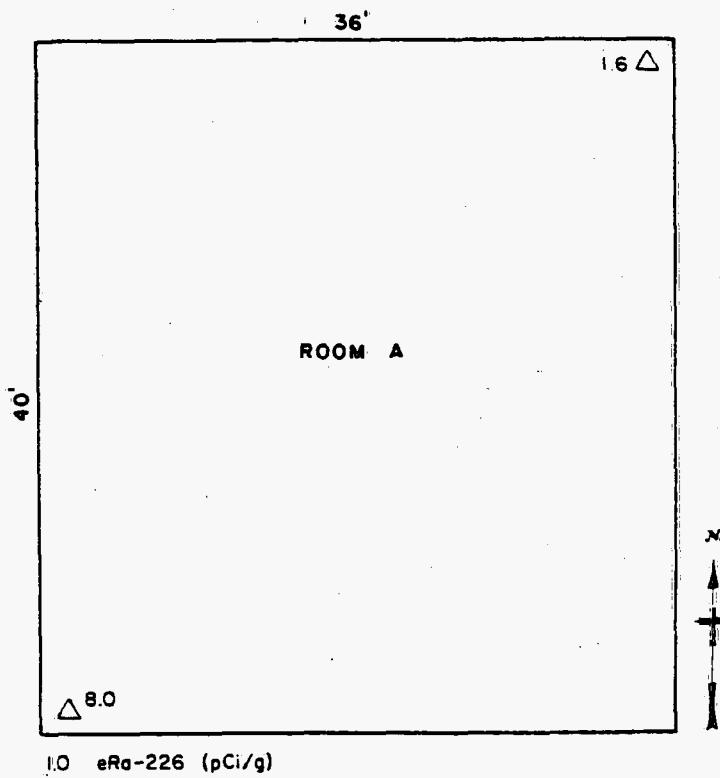


Figure I-35. Building 11 Foundation: Delta-Gamma Measurement Results

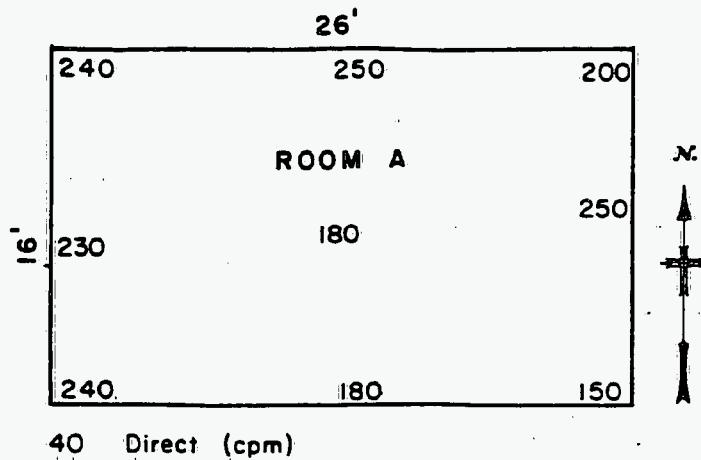


Figure I-36. Building 12 Foundation: Alpha Measurement Results

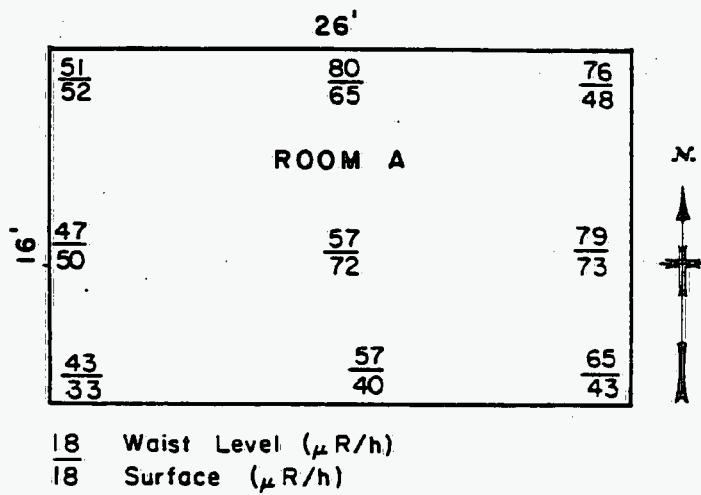


Figure I-37. Building 12 Foundation: Exposure-Rate Measurement Results

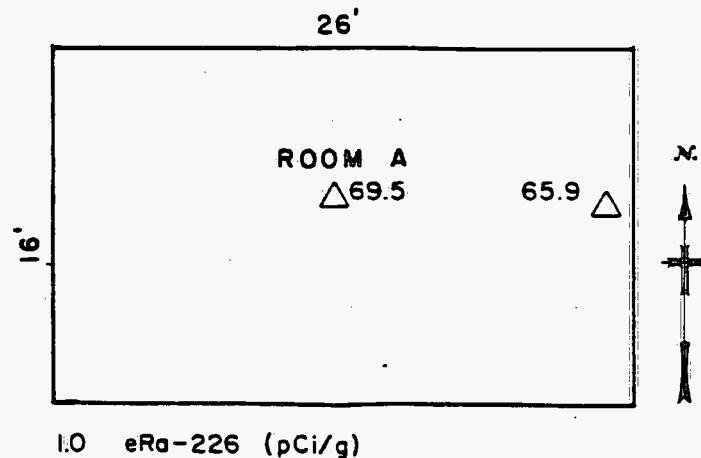


Figure I-38. Building 12 Foundation: Delta-Gamma Measurement Results